

AFOSR

FY 96 Technology Transitions/Transfers

July 1997



19971201 016

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26 November 97

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ABOUT THIS DOCUMENT

This document lists 451 transitions from basic research to applications in the US Air Force, in US industry, and in other defense or nondefense government organizations. Only transitions reported during FY96 are listed; transitions reported in prior years are not repeated in this report.

All reported transitions are the result of basic research funded by AFOSR; this research in many cases is still ongoing. In most cases, the research was initiated years ago, and in a few cases decades ago.

This document reports current transitions as contrasted to the customary historical reporting as to how research laid the foundations for current technology and products. We used the following to define "current transitions":

A technology transition or transfer is a partnership between basic researchers and users where both expend nontrivial and sufficient resources toward realizing a product, process, or analytical objective.

Every entry must meet the requirement that both the supplier and the customer be named and the "item" be described as both a research achievement and a customer benefit. The columns of the pages featuring the detailed entries represent the following:

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|-----------------|--|
| Subarea | numerical designator of the lowest level budgetary breakdown of AFOSR's programs |
| Title | name of the subarea |
| PM | name of responsible AFOSR program manager |
| Performer . . . | name and organization of the AFOSR funded researcher |
| Customer . . . | name and organization of the customer |
| Result | description of the research result(s) |
| Application . | description of the use and/or application objective |

The summary table of the 451 transitions/transfers on page iii provides data grouped in three categories:

a. The category labeled "Performers" summarizes the entries by the performers of research, i.e., by the sectors to which those we sponsor belong. For example, the last entry on Page 1 lists as a performer "Garscadden and Nagpal, WL/POOD" and, thus, counts as a transition from an Air Force laboratory, whereas the last entry on Page 2, performer George Caryotakis, Stanford University, counts as a transition from a university grantee. Note that 31 percent of AFOSR's sponsorship funds goes to intramural research in Air Force laboratories, 64 percent goes to university researchers, and the balance goes to researchers working in industry or other government laboratories.

b. The category labeled "Customers" summarizes the transitions to a user. AFOSR's major customer sectors are the downstream exploratory and advanced development (6.2 and 6.3A) programs in the Air Force laboratories, industrial customers, and customers in other Air Force or governmental organizations. For example, on Page 2, the fifth entry lists a 6.2 customer ("Ms Sandra Fries-Carr, WL/POOC"), the sixth entry is a customer in another governmental organization, the

Naval Research Lab (“Dr R.K. Parker”), and on Page 3, the first entry is an industrial customer (“March Instruments, Inc.”).

Often, the industrial customer is sponsored by 6.2 or 6.3A funds from Air Force laboratories, DARPA, or another Service, or works under contract with DOD acquisition organizations.

c. The category labeled “Application” captures the three principal application objectives: products, processes, and other technology benefits (e.g. data codes, software, etc.). Examples are as follows: the fourth entry on Page 10 is a process application (“provides an alternative production method for producing bulk metallic glass materials”), the second entry on Page 14 is a product application (“development of high performance polyimide materials for composite structures in aerospace aircraft”), and the fourth entry on the same page belongs in the “other benefits” category (“vehicle design for the X-33 program”).

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JOSEPH F. JANNI
Director

1996 BASIC RESEARCH TRANSITIONS

| | |
|---|-----|
| Major Basic Research Transitions to Application | 451 |
| Performers: | |
| AF Laboratories | 136 |
| U.S. Industry | 27 |
| Academia | 288 |
| Customers:* | |
| AF 6.2/6.3A Programs | 82 |
| U.S. Industry | 254 |
| Other Air Force & U.S. Gov't | 123 |
| Application:Product (new or improved) | 22 |
| Process (new or improved) | 230 |
| Other Technology Benefit | 99 |

*Sums of categories exceed fiscal year total due to more than one customer per transition.

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------------------|-------------|--|---|--|---|
| 2301A | Photonic Physics | Schlossberg | Stephen Brueck, University of New Mexico (505) 277-6033 | MRS Technology, Gary Ropiak, (508) 250-0450 | Interference Optical Lithography for Field Emission Displays | Ultrafine lithography for future generation inexpensive field emission projection and helmet mounted displays using optical methods. |
| 2301A | Photonic Physics | Schlossberg | Richard Osgood, Columbia University, (212) 854-4462 | RSoft, Inc., LuAnn Scarnozzino, (914) 734-2665 | Faster, more user friendly, more capable, and more accurate modeling of complex opto-electronic integrated circuits | Design and analysis capability for complex optoelectronic integrated circuits. |
| 2301A | Photonic Physics | Schlossberg | Harold Fetterman UCLA (310) 825-3431 | TRW, John Brook, (310) 812-0087 | Optical control of HEMTs for millimeter wave generation | Means for generating, controlling, and delivering millimeter wave signals for use in phased array radars, especially remote and multi-antenna. |
| 2301C | Optics | Schlossberg | Jack Feinberg, USC (213) 740-1134 | Spectra Diode Laboratories, David Welsh, (408) 943-9411 | Locking of semiconductor lasers using mutual nonlinear phase conjugation | High power, high beam quality, compact semiconductor lasers for directed energy and IR countermeasures application. |
| 2301C | Optics | Schlossberg | Martin Fejer, Stanford University, (415) 725-7509 | David Deacon Deacon Research Corp. (415) 493-6100 | Periodically poled ferroelectric materials | Compact lasers shifted to wavelengths necessary for application in optical and IR countermeasures. |
| 2301C | Optics | Schlossberg | Aaron Lewis, Hebrew University (972) 263-5243 | MFEL Program, Michael Marron, (703) 696-4038 | Near-field scanning optical microscopy | Infrared materials analysis with subwavelength spatial resolution for electronic, structural, and biological understanding and inspection. |
| 2301D | Atomic & Molecular Physics | Kelley | Will Happer, Princeton University, (609) 258-4382 | Magnetic Imaging Technologies, Inc., (MITI), Bastiaam Driehuys, (919) 572-0954 | Laser-polarized gases for in-vivo magnetic resonance imaging (patent number 5,545,396) | Patent licensed to MITI to produce polarized gas production devices for magnetic resonance imaging applications. |
| 2301D | Atomic & Molecular Physics | Kelley | Terry A. Miller, OSU, Biswa N. Ganguly and Peter Bletzinger, WL/POOD, (513) 255-2923 | Dr Jay Jeffries, (415) 859-6341, Phillips Laboratory, OL-AC PL/RFE, Dr Ron Spores SRI International | Absolute H atom density measurement by two-photon laser induced fluorescence | Measurement of molecular hydrogen dissociation as function of input power in an arc jet thruster permits validation of thruster models for energy conversion efficiency. |
| 2301D | Atomic & Molecular Physics | Kelley | Dr Alan Garscadden and Dr Rajesh Nagpal, WL/POOD, (513) 255-2246 | Queens University, Belfast, N. Ireland, Dr Bill Graham, 232-245-133 | H Formation through H2 Rydberg States | Simpler and more efficient plasma chamber design using amplitude modulated rf power sources. |
| 2301D | Atomic & Molecular Physics | Kelley | Biswa N. Ganguly and Peter Bletzinger, WL/POOD, (513) 255-2923 | Johns Hopkins University, Applied Physics Laboratory, Dr David VanWie, (301) 953-5194 | High pressure large volume non-equilibrium plasma generation | A transformation coupled inductively excited plasma source has been developed and is being used in tests of hypersonic drag modification. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|----------------------------|--------|--|---|--|--|
| 2301D | Atomic & Molecular Physics | Kelley | Dr Rajesh Nagpal and Dr Garscadden, WL/POOD, (513) 255-2246; J. Clark, Washington State University | SEMATECH, Dr Gregory Hebrner, (505) 844-6831 | Electron transport data for BC13 and SiF4 | Dollars to WL/POOD from SEMATECH for data on microelectronic etchants and plasma reactor design applicable to the production of military electronics. |
| 2301D | Atomic & Molecular Physics | Kelley | R. Wu, (937) 255-2923, K-Systems | Ms Sandra Fries-Carr, (937) 255-6016, NASA Lewis, Dr Schweickart, (937) 255-9189, WL/POOC (6.2) | Low friction, large area diamond-like carbon (DLC) coatings, and High resistivity DLC films | Tribology for aeronautical and space gearbox applications, and high-temperature capacitors can be used in jet engine electronics and diagnostics. |
| 2301D | Atomic & Molecular Physics | Kelley | D. Schweickart, WL/POOX Dr Alan Garscadden and Dr Rajesh Nagpal, WL/POOD, (513) 255-2246 | WL/POO (more electric initiative), LANTIRN SPO (low-altitude navigation and targeting infrared for night), Dr Dan Schweickart, (937) 255-9189 | Signal processing for statistics of insulation degradation | 270 v connector studies, G. Rhoads, J. Horwath, L. Walko, and for determining qualification standards for high voltage wiring for airborne and aerospace applications. |
| 2301D | Atomic & Molecular Physics | Kelley | Capt Pat Emmert, (937) 255-2923, WL/POOD | Ms Sandra Fries-Carr, (937) 255-6016, WL/POOC (6.2) | High quality diamond films | High temperature capacitors can be used in jet engine electronics and diagnostics. |
| 2301E | Plasma Physics | Barker | Hezhong Guo, (301) 405-5018, University of Maryland | Naval Research Laboratory, Dr R.K. Parker, (202) 767-6655 | Demonstrated the feasibility of ganging higher harmonic gyrotrons to achieve highly efficient AMPLIFIER mode operation | Future zero-weight, switchable field communications system for satellite links. |
| 2301E | Plasma Physics | Barker | George Caryotakis, Stanford University, (415) 926-4446 | Phillips Lab/WSR, Dr Moe Arman, (505) 846-9652 | Perfected unique capability to design and fabricate ultraclean, high vacuum HPM components | PL will directly apply these computational capabilities to their ongoing multimillion dollar 6.2 & 6.3 efforts in the high power microwave source area. |
| 2301E | Plasma Physics | Barker | Reece Roth, University of Tennessee at Knoxville (615) 974-4446 | March Instruments Inc., Mr John Vaspucci, (916) 433-6954 | Demonstrated the use of an efficient glow discharge to generate volumes of plasma in the open atmosphere | Will be applied to aircraft systems under testing to determine feasibility as a method for controlling drag on a wing surface. |
| 2305B | Electronic Devices | Witt | R. Webster, M. Anwar, RL/ERAC, (617) 377-4038 | Lockheed Martin/Sanders, Nashua, NH, Dr John Heaton, (603) 885-1054 | The Rome Lab team solved Schrodinger and Poisson equations self-consistently for HEMT structures, affording materials and geometry guidance to device designers in optimizing design | To be used in the design of various AF and DOD circuit applications, particularly those requiring low-noise, high-frequency operation. |
| 2305B | Electronic Devices | Witt | Chris Bozada, WL/AADD, (937) 255-6871, ext 3458 | Northrup/Grumman ESSD, Dr B. Bayraktaroglu (410) 987-7646 | The Wright Lab team designed and fabricated a thermal-shunt HBT. Produced record levels of power output with best-reported reliability | For use in applications to wireless communications and radar systems. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---------------------------------------|-------|--|--|--|--|
| 2305B | Electronic Devices | Witt | Chris Bozada, WL/AADD, (937) 255-6871, ext 3459 | UES, Inc., Dr R. Bhattacharya, (937) 252-4092 | The Wright Lab team designed and fabricated a thermal-shunt HBT. Produced record levels of power output with best-reported reliability | For use in applications to wireless communications and radar systems. |
| 2305B | Electronic Devices | Witt | Chris Bozada, WL/AADD, (937) 255-6871, ext 3460 | Epitronics, Dr M. Tishler, (602) 581-3663 | The Wright Lab team designed and fabricated a thermal-shunt HBT. Produced record levels of power output with best-reported reliability | For use in applications to wireless communications and radar systems. |
| 2305B | Electronic Devices | Witt | Chris Bozada, WL/AADD, (937) 255-6871, ext 3461 | Spire Corp., S. Vernon, (617) 275-6000 | The Wright Lab team perfected the design and fabrication for an advanced Carbon doped HBT. This device offers advantages for high power/high efficiency applications | For use in applications to wireless communications and radar systems. |
| 2305B | Electronic Devices | Witt | Prof. M. Melloch, Purdue University, (317) 494-3528 | MellWood Laboratories, Dr E. Harmon, (317) 426-3662 | Prof Melloch developed the materials and device capability to produce an ultrafast photodetector operating over the 400-900 nm range | The MellWood Laboratory publicly released a commercial photodetector using this technology in June 1996. |
| 2305B | Electronic Devices | Witt | Dr R. A. Murphy, MIT Lincoln Laboratories, (617) 981-7841 | Hughes Research Laboratory, Malibu, CA, Dr D. Docter, (310) 317-5736 | Dr Murphy perfected a buffer layer using LT GaAs that, when used with PHEMTs, gives improved power performance and reduced backgating | Hughes will use this technology in V-band MMICs for application in space and communication systems. |
| 2305C | Electronic Components & Circuits | Witt | Prof. Chenming Hu, University of California at Berkeley, (510) 642-3393 | SEMATECH Cadence Mentor Graphics Metasoft pSpice (plus 125 others), (512) 445-3463 | A new mobility model has been incorporated into the Berkeley MOSFET IC simulator model. It has been adopted by SEMATECH as the industry standard model and has been widely adopted | The Berkeley BSIM3v3 model is now in routine use as the MOSFET portion of various circuit simulation tools. As such, it finds daily application in all manner of silicon circuit design. |
| 2305C | Electronic Components & Circuits | Witt | Prof. R. Battacharya, University of Michigan at Ann Arbor, MI (313) 763-6678 | Hughes Research Laboratories, Malibu, CA, Dr E. Croke, (310) 317-5321 | The Michigan team has developed a new buffer layer for use in lattice-mismatched SiGe/Si structures that results in defect-free materials | Hughes will use the approach in the production of high frequency HBT circuits. |
| 2305C | Electronic Components & Circuits | Witt | Prof P. Battacharya, University of Michigan at Ann Arbor, MI (313) 763-6678 | NASA Cleveland, Cleveland, OH, Drs S. Alterovitz and G. Ponchak, (216) 433-3517 | The Michigan team has developed a new buffer layer for use in lattice-mismatched SiGe/Si structures that results in defect-free materials | NASA will employ the Michigan technology in the realization of high frequency HBT-based MMICs. |
| 2305D | Optoelectronic Information Processing | Craig | Dr Thomas Mossberg, Physics Department, University of Oregon, Eugene, OR, (541) 346-4779 | Templex Corporation, Larry Brice, Eugene, OR, (503) 382-0976 | Time sequence access techniques for spectroscopic optical memory | High areal density optical memory (10 Gbit/sq in) with ultra-high bandwidth I/O (5 Gbit/sec/channel). Pertinent to AF capture and processing of terabytes per day of surveillance photography, reported by Rome Lab. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---------------------------------------|-----------|--|---|---|--|
| 2305D | Optoelectronic Information Processing | Craig | Dr John Walkup, Electrical Engineering Department, Texas Tech. University, Lubbock, TX, (806) 742-3500 | Dr Ravinder Kachru, Molecular Physics Laboratory PS077, SRI International, Menlo Park, CA 94025 (415) 859-3727 | Analysis of optimal error correction codes for spectroscopic optical memory | High bandwidth, highly parallel interface to spectroscopic optical memory. Application in depositing as well as locating and retrieving pertinent imagery data for visualization or battle management from fused imagery data. |
| 2305D | Optoelectronic Information Processing | Craig | Dr Rufus Cone, Physics Department, Montana State University, Bozeman, MT 59717 (503) 382-0976 | Dr Ralph Hutcheson, Scientific Materials Corp., 310 Icepond Road, PO Box 786, Bozeman, MT (406) 585-3772 | Spectroscopic characterization of thulium doped yttrium aluminum garnet | Best material discovered to date for use in persistent spectral hole burning optical memory. Supports optical DRAM for image buffering and processing at high bandwidth and in field-parallel formats. |
| 2305D | Optoelectronic Information Processing | Craig | Dr Fouad E. Kiamilev, Department of Electrical Engineering, University of North Carolina at Charlotte, Charlotte NC 28223 (704) 547-3345 | Dr Matthew Derstine, Optivision, 3450 Hillview Ave., Palo Alto, CA 94304, (415) 855-1776 | Designed hybrid CMOS-SEED optoelectronic interface chips | Supports parallel interconnect hardware demonstration for optical memory interface. Manages parallel I/O at high bandwidth (~Gigaframe per second) for image database processing applications. |
| 2305D | Optoelectronic Information Processing | Craig | Dr Fouad E. Kiamilev, Department of Electrical Engineering, University of North Carolina at Charlotte, Charlotte NC 28223 (704) 547-3345 | Dr Ashok Krishnamoorthy, Room 4B-523, AT&T Bell Labs, 101 Crawford Corner Road, Holmdel, NJ 07733 (908) 949-1847 | Designed hybrid CMOS-SEED optoelectronic interface chips | Optoelectronic interfaces for parallel crossbar switching in telephone exchange switches and for access to buffer memory. Provides parallel to serial I/O capability for image database communication. |
| 2305E | Semiconductor Materials | Prairie | Prof Stephen Forrest, Dept of Electrical Engineering, Princeton University, Princeton, NJ, (609)258-4532 | Dr Raymond Fok, (310) 333-5186, Dr Jean-Michel Guerin, (310) 333-5191, Mark Geslicki, (310) 333-7013, Xerox Corporation, El Segundo, CA | Developed multicolor, transparent, organic light-emitting device (TOLED) using organic molecular-beam deposition in vacuum | Multicolor head-up displays, visor-mounted displays for pilots, virtual-reality headsets for remotely-piloted vehicles; flat-panel instrument and computer displays. |
| 2305F | Electromagnetic Materials | Prairie | Prof John Ekerdt, Dept of Chemical Engineering, the University of Texas, Austin, TX (512)471-4689 | Jon J. Candelaria, (512) 933-6300 Motorola Corp. | Demonstrated enhanced performance in p-type SiGe MOSFETs (transistors) by engineering the strain and energy properties by adding carbon to the SiGe alloy | High-bandwidth signal processing for real-time battlefield awareness and target discrimination; cellular communication. |
| 2305F | Electromagnetic Materials | Prairie | Dr David Bliss, Rome Lab, RL/ERX, Hanscom AFB, MA (617) 377-4841 | GT Equipment Technologies, Inc., Nashua, NH, Kedar Gupta, (603) 883-5200, | Magnetically-stabilized, liquid-encapsulated Czochralski growth of InP | Optical fiber based, light-weight, on-board sensors and data networks for aircraft and satellites; high-performance microwave/RF transmitters for communication links and countermeasures. |
| 2305G | Quantum Electronic Solids | Weinstock | Dr M.R. Beasley, Stanford University (415) 723-1196 | 3M, Joseph Storer, (612) 733-6462 | Tunable diode laser used in manufacturing process development | HTS tapes for magnets and cables for use in generators and energy storage systems. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---------------------------|-----------|--|--|---|--|
| 2305G | Quantum Electronic Solids | Weinstock | Drs James H. Rose and John Moulder, Iowa State University (515) 294-7537 and 9750 | Sierra Matrix, Inc., John Carruthers, (510) 623-3690 | Software and hardware module for eddy-current measurements of aircraft | Used in the detection and characterization of corrosion in aircraft lap splices. |
| 2305G | Quantum Electronic Solids | Weinstock | Dr David Awschalom, University of California at Santa Barbara (805) 893-2121 | Digital Instruments, Inc., Ken Babcock, (805) 967-1400, ext. 277 | Submicron current imaging technique using magnetic force microscopy | Inspection and characterization of buried conductors in integrated electronics used in communications and information processing. |
| 2305G | Quantum Electronic Solids | Weinstock | Dr David Awschalom, University of California at Santa Barbara (805) 893-2121 | Digital Instruments, Inc., Lucien Ghiselin, (805) 967-1400, ext. 288 | Bent 100-nm near-field optical-fiber cantilevers for existing AFM instruments | Room-temperature scanning near-field optical imaging of integrated laser structures for optoelectronic signal processing. |
| 2305G | Quantum Electronic Solids | Weinstock | Dr John Talvacchio Northrop Grumman STC (412) 256-1437 | US Government and Northrop Grumman Electronic Sensors & Systems Division, H. Ball, (410) 765-0410 | Six-mask-level integrated circuit process for first multilayer HTS digital circuits based on single-flux-quantum (SFQ) logic | 20 Ghz-bandwidth digital receivers for more secure communications. |
| 2305G | Quantum Electronic Solids | Weinstock | Dr John Talvacchio Northrop Grumman STC (412) 256-1437 | DARPA, F. Patten, and Northrop Grumman Electronic Sensors & Systems Division, G. Bates, (410) 765-2535 | Improved HTS films applied to filters switchable between low insertion loss and 50 dB isolation | More secure and lower power requirements for electronic warfare. |
| 2302B | Mechanics of Materials | Jones | Dr Maciej Kumosa University of Denver, Denver, CO (303) 871-3807 | Dr Michael Castelli NASA Lewis Res Ctr Cleveland, OH | Experimental results and mathematical models of micro-level and macro-level failure mechanisms for graphite-reinforced composite materials based on polyimide resins | NASA is exploring the use of advanced high-temperature polymer-matrix composites for turbine engine applications, including cowling structures, to increase the thrust-to-weight ratio of the engines. |
| 2302B | Mechanics of Materials | Jones | Dr Kenneth Reifsnider, Virginia Polytechnic Institute, Blacksburg, VA (703) 231-5316 | Mr Tom Gates NASA Langley Research Center, Hampton, VA | Mechanism-based mechanics models which capture the temperature-driven property changes and long-term environmental degradation of polymer-based composite materials | High-temperature polymer-matrix composites are to be used in the design of the NASA High-Speed Civil Transport (HSCT) for major sections of the airframe to decrease weight and improve performance of this future aircraft. |
| 2302B | Mechanics of Materials | Jones | Dr Asher Rubenstein Tulane University New Orleans, LA (504) 865-5771 | Dr Phillip Adler Northrup-Grumman Co., Bethpage, NY | Analysis methodology for internal damage in ceramic-matrix composite materials which accounts for matrix cracking and fiber/matrix interface debonding | Northrup-Grumman Corporation is considering using advanced ceramic-matrix composites in high-temperature applications in their low-cost ceramic composites program if the failure mechanisms of these materials can be understood. |
| 2302B | Mechanics of Materials | Jones | Dr Aular Kaw, University of South Florida Tampa, FL (813) 974-5626 | Dr Allan Katz WL/MLL WPAFB, OH (513) 255-9824 | Mathematical models of damage growth in ceramic-matrix composites which account for matrix cracking as the crack approaches a fiber and produces fiber/matrix interface debonding | Wright Laboratory is developing ceramic-matrix composites for advanced aerospace engine applications, and the modeling of the initiation and growth of internal damage is critical to safe operation in service. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|------------------------|---------|--|--|---|--|
| 2302B | Mechanics of Materials | Jones | Dr A. F. Grandt Purdue University (317) 494-5117 | Mr James Rudd WL/FIB WPAFB, OH | Analysis methods for multiple-site damage can account for numerous small fatigue cracks around fastener holes in aircraft structures and the associated reduction in strength | Large-scale tests are being conducted to determine the reduction in residual strength caused by multiple-site damage in aircraft structural members, and the analysis methods are necessary to interpret test results. |
| 2302B | Mechanics of Materials | Jones | Dr Robert Wei, Lehigh University Bethlehem, PA (610) 758-3585 | Mr James Rudd WL/FIB, WPAFB, OH | Mechanistic models of corrosion and fatigue which consider the interaction of chemical and mechanical degradation in order to produce realistic life models for aircraft structures | These mechanistic models are being incorporated into actual life prediction computer codes, such as MODGRO, which are used to certify flight safety for a wide range of Air Force aircraft. |
| 2302C | Particulate Mechanics | Chipley | Jack Dvorkin, Stanford University, (415) 725-9296 | Jeff Rish, WL/FIVC Tyndall AFB, FL, (904) 283-3705 | First principle contact laws | An improved airfield pavement design and life cycle analysis accounting for long-term creep of asphalt binders. |
| 2302C | Particulate Mechanics | Chipley | C. S. Chang, University of Massachusetts, (413) 545-5401 | Jeff Rish, WL/FIVC Tyndall AFB, FL, (904) 283-3706 | Upper/Lower bound limits | An improved airfield pavement design and life cycle analysis accounting for long-term creep of asphalt binders. |
| 2302C | Particulate Mechanics | Chipley | Gary Olhoeft, Colorado School of Mines, (303) 273-3458 | Tom Stauffer, AL/EQC, Tyndall AFB, FL (904) 283-6059 | Multi-channel data acquisition system for Complex Resistivity Measurement | A low-cost method for site characterization of Air Force installation contaminated soils and groundwater for long-term monitoring. |
| 2302C | Particulate Mechanics | Chipley | Ben Sternburg, University of Arizona, (602) 621-2439 | Tom Stauffer, AL/EQC, Tyndall AFB, FL (904) 283-6060 | Multi-band ground penetrating radar | A low-cost method for site characterization of Air Force installation contaminated soils and groundwater for long-term monitoring. |
| 2302C | Particulate Mechanics | Chipley | Roman Hryciw, University of Michigan, (313) 763-5491 | Tom Stauffer, AL/EQC, Tyndall AFB, FL (904) 283-6061 | Borehole Imaging System | A low-cost method for site characterization of Air Force installation contaminated soils and groundwater for long-term monitoring. |
| 2302C | Particulate Mechanics | Chipley | Tony Saada, Case Western Reserve University, (216) 368-2427 | Jeff Rish, WL/FIVC Tyndall AFB, FL, (904) 283-3706 | Shear band measurement in granular soils | A new method of geomaterial characterization to determine earth penetrators parameters. |
| 2302D | Structural Mechanics | Sanders | Ali Nayfeh, Virginia Tech, 231-5453 | Cessna Aircraft Company, John Axtell, (316) 941-6000 | Computer code coupling nonlinear unsteady aerodynamics, structural dynamics, and control systems | Predict on set of flutter, post-flutter behavior, and active flutter control. |
| 2302D | Structural Mechanics | Sanders | Ali Nayfeh, Virginia Tech, 231-5454 | Wolfram Research, Cetin Cetinkaya, (217) 398-0700 | Mathematical based software to solve (approx.) an arbitrary set of non-linear differential equations | Structural dynamics, power systems, ships, submarines, and aircraft. |
| 2302D | Structural Mechanics | Sanders | Michael Howe, Boston University, (617) 353-5869 | Navy, NSWC, Bill Blake, (301) 227-1879 | Methodologies for predicting vibration damping of perforated elastic plates | Sound and vibration problems of ships and submarines. |
| 2302D | Structural Mechanics | Sanders | Earl Dowell, Duke University, (919) 660-5389 | Wright Laboratory, Mark Hopkins, (513) 255-7384; Pratt and Whitney, Gary Hilbert, (860) 565-5422 | Reduced Order Modeling Methodologies for Aerodynamic Models | Aeroelastic analysis of highly flexible aircraft structures. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------------------|---------|---|--|--|---|
| 2302D | Structural Mechanics | Sanders | Tinsley Oden, Computational Mechanics Company, Inc., (512) 467-0618 | NASA, Voloria Martinson (512) 467-0618; Goodyear, Dr Michael Trinko, (330) 796-1722 | Friction Model has been incorporated into TIRE3D/TCAN | Analysis of nonlinear deformations of tires. |
| 2302D | Structural Mechanics | Sanders | John Junkins, Texas A&M, (409) 845-3947 | E-Systems | Multiresolution and wavelet techniques | Crack growth and corrosion detection in NDE of USAF RC135. |
| 2302D | Structural Mechanics | Sanders | John Junkins, Texas A&M, (409) 845-3948 | Lockheed Martin, Denver | Dynamic and control methodology for fine pointing of flexible structures | Large spacecraft and structures. |
| 2306A | Metallic Structural Materials | Ward | J. Beuth, Carnegie Mellon University, (412) 268-3873 | Ohmer Erdmann, GE Aircraft Engines, (513) 243-9908 | Experimental and analytical results show that low ductility materials can eliminate elastic stress concentrators | Blade root design for low pressure turbine blades made of TiAl. |
| 2306A | Metallic Structural Materials | Ward | S. L. Semiatin, WL/MLLN, (513) 255-1345 | J.T. Morgan, F-22 SPO, (513) 255-1711, x2397 | Model of fracture during hot working of TiAl used to develop criteria for strain-induced porosity in alpha-beta titanium alloys | Large plan-view airframe forgings such as bulkheads for F-22. |
| 2306A | Metallic Structural Materials | Ward | Linda Rishel, Carnegie Mellon University, (412) 268-2973 | W. Johnson, (818) 395-4411, Amorphous Technologies International | First use of Induction Skull Melting (ISM) technique to produce amorphous alloys | Provides an alternative production method for producing bulk metallic glass materials. |
| 2306A | Metallic Structural Materials | Ward | R.E. Dutton, WL/MLLN, (513) 255-9396 | R. Weaver, Coors Ceramic Company, (303) 277-4116 | Knowledge of material behavior during powder consolidation applied to "slumping" during sintering of aluminum titanate and transformation-toughened zirconia | Used for automotive engine and exhaust components. |
| 2306A | Metallic Structural Materials | Ward | T. Pollock, Carnegie Mellon University, (412) 268-2973 | C. Austin, GE Aircraft Engines, (513) 243-2114 | Effects of microstructural variability on mechanical properties of TiAl castings | Enhanced processing modifications for casting TiAl low pressure turbine blades. |
| 2306A | Metallic Structural Materials | Ward | P. Steif, Carnegie Mellon University, (412) 268-3507 | C. Austin, GE Aircraft Engines, (513) 243-2114 | Determination of effects of indenter geometry on material response | Better experimental characterization technique for simulating Foreign Object Damage (FOD) on turbine blade materials. |
| 2306A | Metallic Structural Materials | Ward | K. Muraliedharan, Carnegie Mellon University, (412) 268-3507 | S. Ram, Precision Cast Parts, (503) 777-3881; C. Austin, GE Aircraft Engines, (513) 243-2114; P. Martin, Rockwell International Science Center, (805) 373-4274 | Established World Wide Web site for dissemination of TiAl-relevant research results. First included was metallographic preparation techniques | Provides standard TiAl metallographic preparation technique for use by researchers across the nation. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---|----------|---|--|--|---|
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Helen Chan, Lehigh University, (610) 758-5554 | TDA Research, Inc., Jack Sibold, (303) 422-7819 | Small additions of Yttrium and Lanthanum greatly increase creep resistance of alumina ceramic materials | Very high temperature oxide fibers for composites for engine-related applications. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | W. P. Hoffman, DSN PL/RKFE, 275-5768 | Virginia Tech., FDA, Scott Keller, (540) 231-8697 | Carbon microtubes of accurately-controlled dimensions can be used to measure microbial intrusion in food packaging | Standard for food and medical packaging testing. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | W. P. Hoffman, DSN PL/RKFE, 275-5768 | Thiokol, John Shigley, (801) 863-2381 | Process for in-situ densification of carbon and ceramic composites, that reduces processing time 100-fold | Rocket propulsion and hypersonic components, and aircraft brakes. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | W. Kriven, University of Illinois (217) 333-5258 | McDonnell Douglas, Dr James French, (314) 777-5243 | Super-strength amorphous oxide fibers | Composites for structural applications of aircraft. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | W. Kriven, University of Illinois (217) 333-5258 | Pratt & Whitney, Rowena Ecklund, (407) 796-2000, Oak Ridge Lab., Ferber, (423) 576-0818, German Aircraft Research (DLR), Harthmut Schneider, 49-2203-6012430 | Amorphous oxide fibers process and development. Yttrium phosphate laminates and coatings | Targets for nuclear fusion. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Jack Lackey, GTRC (404) 894-0573 | Ceramic Composites, Inc., Larry Fehrenbacher, (301) 261-8373, Knolls Atomic Power Laboratory, Lynne Kolaya, (518) 395-5209, Bettis Atomic Power Laboratory, Wayne Ohlinger, (412) 476-6549 | A new approach to fabricating ceramic matrix and carbon matrix composites. The approach is based on producing laminated matrix with very high toughness and environmental stability. The new process for fabricating laminated matrix composites | Radiators, heat exchangers, a number of classified applications, and thrust chambers for engines. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | John Brennan, UTRC, (860) 610-7220 | Pratt and Whitney/GESP, Robert Warburton, (407) 796-2347 and Bob Miller (407) 796-5972 | Technology for fabricating ceramic-matrix composites based on BN-coated SiC fibers (Nicalon) in glass-ceramic matrix (BMAS) | NASA HSCT/EPM gas turbine engine acoustic nozzle liner based on Helmholtz resonator principle. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Ken Sandhage, Ohio State University, (614) 292-6731 | Edward Orton Ceramic Foundation, J. Richey Schorr and Wei-wah Chen, (614) 895-2663 | The Solid Metal-Bearing Precursor method for fabricating BaTiO ₄ thermistors | Temperature sensing via PTCR, and for measuring temperature at a point. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---|----------|--|---|---|---|
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Ken Sandhage, Ohio State University, (614) 292-6731 | Target Materials, Inc., Columbus, OH, J.R. Gains, (614) 486-0261 | A method for fabricating cylindrical ceramic sputtering targets utilizing the zero-shrinkage features of the SMP process | Sputtering targets for numerous military and industrial applications. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Ken Sandhage, Ohio State University, (614) 292-6731 | Bobcock and Wilcox, Richard Gettler, (804) 522-6418 | A processing technique utilizing Mg infiltration in porous alumina ceramics with subsequent oxidation of metal to produce spinel ceramics | Ceramic engine components, both monolithic and fiber-reinforced. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | John Brennan, UTRC, (860) 610-7220 | Pratt and Whitney/GESP, Robert Warburton (407) 796-2347, and Bob Miller, (407) 796-5972 | Technology for fabricating ceramic-matrix composites based on BN-coated SiC fibers (Nicalon) in glass-ceramic matrix (BMAS) | NASA HSCT/EPM gas turbine engine acoustic nozzle liner based on Helmholtz resonator principle. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | W. Sproul, BIRL, (847) 491-4108 | Greenfield Industries, T. Muehlhans, (706) 650-4102 | Nano-layered Nitride and Oxide Coatings show excellent properties in wear and cutting applications | Improving properties of high-speed cutting drills for manufacturing parts from metals, ceramics and polymers. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | W. Sproul, BIRL, (847) 491-4108 | Kenametal Co., Dennis Quito, (412) 539-4851 | Nano-layered oxide coatings. Novel materials, their properties, and the process of manufacturing | Coatings for tools for dry-machining of very hard materials. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Wang Ming-Show, BIRL, (847) 491-2746 | Ford Motors, Bill Wessel, (313) 323-8984 | New laminated carbon nitride/TiN and Carbon nitride ZrN coatings show extreme stability in cutting conditions; the process for production of these coatings | Cutting tools and drilling inserts for processing parts made of metals and polymers. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Wang Ming-Show, BIRL, (847) 491-2746 | Timken Co., Harvey Nixon, (330) 471-2046 | Ultra-hard carbon nitride coatings and the process to produce them | Major improvements in life of steel bearings. |
| 2306B | Ceramic & Non-metallic Structural Materials | Pechenik | Sankar Sumbasevan, BIRL, (847) 491-4619 | Bobcock and Wilcox, Dr Rich Goettler, (804) 522-6418 | New sol-gel approach to coating fibers and surfaces with lanthanum phosphate | Land-based turbine engines, heat exchangers, hot gas filters. |
| 2306C | Organic Matrix Composites | Lee | Dr Chuk Leung, Poly Comp., (619) 535-9474 | John Glatz, Sparta Inc., (619) 350-1830 | PMR-15 Types Polyimides | Development of materials for missile and projectile nose cones. |
| 2306C | Organic Matrix Composites | Lee | Dr Chuk Leung, Poly Comp., (619) 535-9475 | J. M. Jacobs, Rohr Inc., (909) 351-5400 | PMR-15 Types Polyimides | Development of materials for aircraft engine nacelles and structures. |
| 2306C | Organic Matrix Composites | Lee | Dr Chuk Leung, Poly Comp., (619) 535-9476 | J. McCormack, GE Engines, (513) 243-4417 | PMR-15 Types Polyimides | Development of materials for aircraft engine nacelles and structures. |
| 2306C | Organic Matrix Composites | Lee | Dr Roger Morgan, Michigan State University, (517) 839-8502 | Dr John Russell, WL/MLBC, (513) 255-1471 | Microcrack formation and growth characterization in BMI-C fiber composites | Life prediction of composite structures in aircraft. |
| 2306C | Organic Matrix Composites | Lee | Dr Roger Morgan, Michigan State University, (517) 839-8503 | Dr Dick Cornelia, DuPont, (619) 350-1830 | Moisture saturated polyimide carbon fiber composites damage mechanism | Development of high performance polyimide materials for composite structures in aerospace aircraft. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------------------------|--------|--|--|---|--|
| 2306C | Organic Matrix Composites | Lee | Dr Roger Morgan, Michigan State University, (517) 839-8504 | Dr Anna Yen, Northrop, (310) 942-5392 | Moisture saturated polyimide carbon fiber composites damage mechanism | Materials development for aerospace aircraft. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Steve Schneider, Purdue University, (317) 494-3343 | Harris Hamilton, NASA LaRC | Boundary layer transition data | Vehicle design for the X-33 program. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Steve Schneider, Purdue University, (317) 494-3344 | Dr S. Tagaki, Japanese National Aerospace Laboratory, Japan | Quiet tunnel transition data | Transition location on high-speed civil transport configuration. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6692 | Maj Rich Patterson, Air Force Seek Eagle Program Office (AFSEO) | Wall functions applied to F-22 solution | Weapons release design for the F-22. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6693 | Maj Rich Patterson, Air Force Seek Eagle Program Office (AFSEO) | Aero loads on Mk-82 LDGP | Weapons release design for the F-22. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6694 | Mr Clark Mickelson, US Army Missile Command (MICOM) | Wall functions for missile plume | AIM-7 missile plume prediction for use on aircraft. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6695 | Mr Clark Mickelson, US Army Missile Command (MICOM) | Dynamic motion in computational fluid dynamic simulation | Tumbling fuel tank trajectory ballistic accuracy application. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6696 | Maj Rich Patterson, Air Force Seek Eagle Program Office (AFSEO) | Dynamic motion in computational fluid dynamic simulation | Mk-82 release from B-2 bay under full weapons load. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6697 | Vernon Eachus, Lockheed-Martin | Dynamic motion in computational fluid dynamic simulation | THAAD missile staging. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6698 | Pete Amstutz, F-22 SPO | Dynamic motion in computational fluid dynamic simulation | Maneuvering F-22 performance; and combined roll-pitch-yaw. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6699 | Steve Worth, Lockheed Skunkworks | Wall functions on X-33 SSTO | Jet effects on X-33 single stage to orbit (SSTO) vehicle. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6700 | Barry Acker, OC-ALC | B-1B flare trajectory analysis | Analyses of B-1B flare strike accidents. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------------------------|-----------|---|---|---|--|
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6701 | Capt Steve Herzig, ASD/YME, Eglin AFB | Wall functions for AIM-120 | Calculation of AIM-120 pylon loads on aircraft. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6702 | Alex Krynytzky, NASA/NWTC | Wall functions for national wind tunnel | Assessments of national wind tunnel complex design. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6703 | Jim Engle, F-22 SPO | 16T and 16S contraction flow quality | Analyses of tunnels 16T and 16S flow stability. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Fred Shope et. al., Sverdrup, AEDC, (615) 454-6704 | Jim Engle, F-22 SPO | High alpha F-22 tests | Calculation of F-22 high angle of attack characteristics. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Doyle Knight, Rutgers University, (908) 445-4464 | Marty Haas, UTRC | High-speed inlet simulations | Analyses of NAVY cruise missiles design for Project "Cheapshot". |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Brian Smith, LMTAS, (817) 935-1127 | F-22 SPO | Internal weapons bay large eddy simulation (LES) code | Simulations of F-22 transonic weapons release. |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Rainald Lohner, (703) 993-4075 | Norm Malmuth, Rockwell Science Center | Dynamic motion in computational fluid dynamic code | B-1B weapons release |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Dr Scott McRae, North Carolina State, (919) 515-5244 | Carl Trexler, NASA Langley | Dual-mode scramjet flowfields | Earth-to-orbit vehicles design |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Iain Boyd, CALTECH (607) 255-4563 | Dr K. Zhu, Rockwell Inc. | Low-density hypersonics | Satellites and low-earth orbit vehicles |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Iain Boyd, CALTECH (607) 255-4564 | Dr I. Min, Aerospace Corp. | Parallel Direct Simulation Monte Carlo (DSMC) Code | Low-density plumes for satellites |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Iain Boyd, CALTECH (607) 255-4565 | Dr F. Lumpkin, NASA Johnson Center | Parallel Direct Simulation Monte Carlo (DSMC) Code | Low-density plumes for satellites |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Iain Boyd, CALTECH (607) 255-4566 | Dr A. Droeger, NASA Marshall | Parallel Direct Simulation Monte Carlo (DSMC) Code | Low-density plumes for satellites |
| 2307A | External Aerodynamics & Hypersonics | Sakell | Iain Boyd, CALTECH (607) 255-4567 | Dr M. Marconi, AER Inc, Cambridge MA | Parallel Direct Simulation Monte Carlo (DSMC) Code | To evaluate flow over probes traveling through planetary atmospheres |
| 2307B | Turbulence & Internal Flows | McMichael | Dr D.E. Parekh and A.B. Cain, McDonald Douglas Aerospace (MDA), (314) 233-4324 and (314) 233-2526 | Wright Labs and MDA, Dr Steve Walker, (937) 255-6207 | Design and scaling guidelines for WL nozzle integration study | Plume mixing enhancement (Fluidic Injection Nozzle Technology) and an MDA full-scale demonstration of active mixing technology |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-----------------------------|-----------|--|---|--|---|
| 2307B | Turbulence & Internal Flows | McMichael | Dr D.E. Parekh, MDA, Dr C.B. Rogers, Tufts University, Dr A. Glezer, Georgia Tech., (314) 233-4324 and (404) 894-3266 | MDA, Dr Val Kibens, (314) 233-3811 | Characterization of two-phase flow inside nozzle and in jet plume | New high aspect ratio nozzle designs currently being developed by McDonnell Douglas Corporation Flashjet Program. |
| 2307B | Turbulence & Internal Flows | McMichael | Dr's Ari Glezer and Mark G. Allen, Georgia Tech., (404) 894-3266 and (404) 894-9419 | MDA and NASA, Langley, Dr Richard Wiezien, (757) 864-5532 | Synthetic jet actuators and other novel actuator concepts for use in mixing enhancement, thrust vectoring and aerodynamic shape modification | Flight test program on the YC-15 which is being refurbished as a technology development testbed for the C-17. |
| 2307B | Turbulence & Internal Flows | McMichael | Dr C.M. Ho, UCLA, Caltech, (310) 825-9993 | Dr Tom Austin, (310) 982-9555, MDA, NASA, Dryden, Dr Paul Smith, Naval Surface Warfare Center | Development and Implementation of MEMS shear stress sensors | Instrumentation of McDonnell Douglas industrial wind tunnel for use in McDonnell Douglas aircraft development, NASA/Dryden flight test of micro sensors, sensors for underwater test. |
| 2308A | Space Power & Propulsion | Birkan | B.T. Zinn, Georgia Tech. (404) 894-3033 | David Amos, Westinghouse Electric Corp., (407) 281-3263 | Magnetostriuctive actuator fuel injection system | To stabilize low Nitride Oxides NOX FT8 gas turbine for power generation. |
| 2308A | Space Power & Propulsion | Birkan | B.T. Zinn, Georgia Tech. (404) 894-3033 | Pratt and Whitney, UTRC C.N. Nett (203) 727-7957 | Observer for real-time determination of the characteristics of the instability | Will be applied to unstable jet engines and compressor systems to eliminate stall and noise. |
| 2308A | Space Power & Propulsion | Birkan | E.Y. Choueiri and R.G. Jahn, Princeton University (609) 258-5220 | Science Research Labs, Inc., J. Jacobs (617) 547-1122 | Laser-Interferometer-based Microthruster stand | Impulse Measurements of new Pulsed Plasma Thruster developed by SRL, Inc. for future microsatellites. |
| 2308A | Space Power & Propulsion | Birkan | E.Y. Choueiri and R.G. Jahn, Princeton University (609) 258-5220 | General Research Corporation, G. Dhalen (805) 964-7724 | Laser-Interferometer-based Microthruster stand | Impulse Measurements of deflagration plasma thruster developed by GRC for future microsatellites. |
| 2308A | Space Power & Propulsion | Birkan | M.A. Cappelli Stanford University (415) 725-2020 | Loral IRIS, J. Mroczkowski (617) 863-3064 | GaN and AlN synthesis using arecjet thrusters | Fabrication of UV radiation sensors and detectors. |
| 2308A | Space Power & Propulsion | Birkan | M. Martinez-Sanchez MIT Laboratories, (617) 253-5613 | C.S. Draper Laboratory, M. Socha (617) 258-2126 | Design and construction of 50W Hall Thruster following basic scaling from 1.3 kW existing engine | Drag cancellation for future microspacecraft from Draper Laboratories. |
| 2308A | Space Power & Propulsion | Birkan | T.B. Brill, University of Delaware, (302) 831-6079 | SECA, Inc., R.C. Farmer (205) 534-2008 | Kinetics and Species of Pyrolysis of HTPB | Modeling of 250K lb. experimental thrust hybrid rocket for launch systems and missiles. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|--------------------------|----------|--|---|--|--|
| 2308A | Space Power & Propulsion | Birkan | I.D. Boyd, Cornell University, (607) 255-4563 | I. A. Min, Aerospace Corporation, (310) 336-2868 | Parallel Direct Simulation Monte Carlo (DSMC) Code | Spacecraft contamination |
| 2308A | Space Power & Propulsion | Birkan | I.D. Boyd, Cornell University, (607) 255-4563 | K. Zhu, Rockwell Corporation, (818) 586-0577 | Parallel Direct Simulation Monte Carlo (DSMC) Code | Spacecraft contamination |
| 2308A | Space Power & Propulsion | Birkan | A. Fontijn, Rensselaer Polytechnic Institute, (518) 276-6508 | H. S. Pergament, Propulsion Science & Technology Inc., (609) 924-1070 | Dominance of CO2 continuum emission from 200-270 nm | Missile warning systems on aircraft and helicopters. |
| 2308A | Space Power & Propulsion | Birkan | C. K. Law, Princeton University (609) 258-5271 | NGB Technologies, Inc., G. Tryggvason (313) 763-1049 | Dynamics of droplet collisions | Code validation and verification studies for droplet collisions. |
| 2308A | Space Power & Propulsion | Birkan | R. Burton, University of Illinois, (217) 244-6223 | Col. P. Rustan, USAF, (703) 506-5057, NRL M. Osborn, (202) 767-9168 | High efficiency microthruster | Small satellites |
| 2308B | Airbreathing Combustion | Tishkoff | Dr C. K. Law, Princeton University, (609) 258-5271 | Mr John Petri, Universal Oil Products, Des Plaines IL, (847) 391-3156 | Experimental determination of laminar flame speeds and flammability limits of combustible mixtures | Assessment of flashback and explosion hazards of chemical reactors - refinery safety measure for the production of aviation fuels and lubricants. |
| 2308B | Airbreathing Combustion | Tishkoff | Dr S. M. Correa, General Electric Corporate Research and Development, (518) 387-5853 | Mr David Burrus, General Electric Aircraft Engines, Evendale OH, (513) 243-2611 | Physical/chemical combustion submodels | Incorporation into the CONCERT three-dimensional gas turbine design computer code for advanced aeropropulsion systems, such as IHP/TET Phase III and beyond. |
| 2308B | Airbreathing Combustion | Tishkoff | Dr Daniel E. Rosner, Yale University, (203) 432-4391 | Dr M. B. Dowell, Advanced Ceramics Corp., (216) 529-3900 | Correlation for chemical vapor deposition | Design of SiC yarn fiber coating processes for aerospace composite materials in lightweight airframes for future aircraft and aerospace vehicles. |
| 2308B | Airbreathing Combustion | Tishkoff | Dr S. B. Pope, Cornell University, (607) 255-4314 | Dr M. S. Anand, Allison Engine Company, Indianapolis IN, (317) 230-2828 | Velocity-frequency-composition PDF code | Design calculation methodology for future gas turbine engines, such as IHP/TET Phase III and beyond. |
| 2308B | Airbreathing Combustion | Tishkoff | Dr Tim Edwards, WL/POSF, (513) 255-3524 | Dr Terry Ronald, WL/MLLM, WPAFB, OH, (937) 255-1237 | Data for coking, fuel/superalloy compatibility at 1400 F | HyTech scramjet materials evaluation for hydrocarbon-fueled aeropropulsion at Mach 6 and above. |
| 2308B | Airbreathing Combustion | Tishkoff | Dr Tim Edwards, WL/POSF, (513) 255-3524 | Mr B. Bossi, NAWC/MPNS, China Lake CA, (619) 927-2896 | JP-10 fuel thermal stability information, test stand fuel system design | Scramjet injector testing for HyTech and other programs. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------------|----------|---|---|---|--|
| 2308B | Airbreathing Combustion | Tishkoff | Dr Tim Edwards, WL/POSF, (513) 255-3524 | Mr Lyle Parker, Betz Process Chemical, Woodlands TX, (281) 367-2442 | Quartz crystal microbalance for fuel thermal stability tests | JP-8 fuel thermal stability additive development. |
| 2308B | Airbreathing Combustion | Tishkoff | Dr Tim Edwards, WL/POSF, (513) 255-3524 | Mr Tedd Biddle, Pratt and Whitney Engines, West Palm Beach FL, (561) 796-1201 | Quartz crystal microbalance for fuel thermal stability tests | JP-8 fuel thermal stability additive development. |
| 2308B | Airbreathing Combustion | Tishkoff | Dr W. M. Roquemore, WL/POSC, (513) 255-6813 | Dr H. C. Mongia, General Electric Aircraft Engines, Evendale OH, (513) 243-2552 | Direct numerical simulation for diffusion flames | IHPTET Phase III combustor design. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. K. Hanson, Stanford University, (415) 723-1745 | Dr Mark Allen, Physical Sciences, Inc., Andover MA, (508) 689-0003 | Method for measuring air mass flux by spectrally resolved absorption of oxygen using a tunable diode laser | Mass flux measurement in a ground test of an F-100 engine. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. K. Hanson, Stanford University, (415) 723-1745 | Dr Peter DeBarber, MetroLaser, Irvine CA, (714) 553-0688 | Planar laser-induced fluorescence (PLIF) imaging of high temperature nonreacting flow using acetone tracer | Extension of the FlameMap PLIF Imaging System - advanced laser diagnostic for aircraft and space launch combustor research and development. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. K. Hanson, Stanford University, (415) 723-1745 | Dr Mike Holden, Calspan Corporation, Buffalo NY, (716) 631-6853 | Diode laser-based sensor for water vapor | Measurement of test time in hypersonic shock tunnel testing facility. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. K. Hanson, Stanford University, (415) 723-1745 | Dr Lawrence Cohen, GenCorp/Aerojet, Sacramento CA, (916) 355-5182 | PLIF imaging of hydroxyl radicals in combustion gases | PLIF measurements in ground testing of the Titan IV Stage 1 engine. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. K. Hanson, Stanford University, (415) 723-1745 | Mr Mark Newfield, NASA Ames Research Center, Moffet Field CA, (650) 604-4893 | Diode laser methods to probe high temperature gases using spectrally resolved absorption | First application of diode laser sensing in high-enthalpy arcjet spacecraft thruster test facilities. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr H. G. Hornung, California Institute of Technology, (818) 395-4551 | Mr M. Brown, MetroLaser, Irvine CA, (714) 553-0003 | Laser-Induced Thermal Acoustics (LITA) measurement technique | NASA-funded hypersonics tests. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. B. Miles, Princeton University, (609) 258-5131 | Dr R. Seasholtz, NASA Lewis Research Center, Cleveland OH | Iodine absorption model | Pressure, temperature, and velocity optical imaging in propulsion systems. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. B. Miles, Princeton University, (609) 258-5131 | Dr Michael W. Smith, NASA Langley Research Center, Hampton VA | Iodine absorption model | Pressure, temperature, and velocity imaging for scramjet propulsion testing. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|------------------------|----------|--|---|--|---|
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. B. Miles, Princeton University, (609) 258-5131 | Dr Michael S. Smith, MicroCraft Technology, AEDC, Arnold AFB TN | Iodine absorption model | Supersonic wind tunnel testing. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. B. Miles, Princeton University, (609) 258-5131 | Dr John Lowrance, Princeton Scientific Instruments, Inc., Monmouth Junction NJ | Pulse burst laser | MHz-rate imaging system for general aerospace aerodynamics and propulsion research and development. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. B. Miles, Princeton University, (609) 258-5131 | Dr Leigh Bromley, Positive Light, Inc., Los Gatos CA | Pulse burst laser | Commercial laser system for high-speed imaging relevant to aerodynamics and propulsion system research and development. |
| 2308C | Propulsion Diagnostics | Tishkoff | Dr R. B. Miles, Princeton University, (609) 258-5131 | Mr Glen Rines, Schwartz Electro-Optics, Inc., Concord MA | Mercury vapor filter/narrow band Ti:sapphire laser | Commercial laser/measurement diagnostic technique for research and development of combustors and hypersonic aerodynamic systems. |
| 2303B | Surface Science | DeLong | Steve Sibener, University of Chicago (773) 702-7193 | Mark Greenbaum, Topometrix Corp., (708)-717-0566 | Electronics for high-impedance STM imaging (developed to satisfy a basic research need) | Circuitry needed for commercial Scanning Tunneling Microscope (STM) to image molecular overlayers. |
| 2303B | Surface Science | DeLong | Steve Sibener, University of Chicago (773) 702-7194 | Bruce Zabransky, Argonne National Laboratory, (630) 252-4046 | Ultra-High vacuum technology for atomic traps | Generation of ultra-low temperature atomic beams for atomic/synchrotron physics and small-scale pattern deposition. |
| 2303B | Surface Science | DeLong | Steve Sibener, University of Chicago (773) 702-7195 | Hiroshi Kajiyama, 81492966006, and Hrvoje Petek, Advanced Research Laboratory, Hitachi Ltd., Japan | Multiple supersonic molecular beam methods of materials growth | Improved growth of advanced semiconductors for electronic devices. |
| 2303B | Surface Science | DeLong | Steve Sibener, University of Chicago (773) 702-7196 | Wilson Li, Intel Corp., (408) 765-2837 | Electron enhanced oxidation of materials | Improved oxidation and patterning of semiconductors for electronic device applications. |
| 2303B | Surface Science | DeLong | Kent Eisentraut, WL/MLBT, (513) 255-4860 | Tom Jackson, WL/POSL, (513) 255-5568 | PFPAL liquid lubricant | Provided candidate IHP/TET Phase II lubricants for evaluation. |
| 2303B | Surface Science | DeLong | Kent Eisentraut, WL/MLBT, (513) 255-4860 | Steve Didzulis, Aerospace Corp., (310) 336-0460 | Liquid lubricant technology | Used for spacecraft lubrication applications. |
| 2303B | Surface Science | DeLong | Jeffrey Zabinski, WL/MLBT, (513) 255-8544 | Steve Didzulis, Aerospace Corp., (310) 336-0460 | Functionally gradient and multilayered diamond like carbon coatings | Used for doubling lifetime of satellite systems employing momentum control devices. |
| 2303B | Surface Science | DeLong | Jeffrey Zabinski, WL/MLBT, (513) 255-8544 | Andy Both, Holman Plating and Manufacturing Co., (513) 228-2191 ext. 250 | Plasma emission based process for vacuum-arc deposition of multicomponent transition metal nitrides | Metal nitride coated components using this technology are flying in Air Force systems. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-----------------|--------|---|--|---|--|
| 2303B | Surface Science | DeLong | Larry Henth, University of Florida (904) 462-5445 | Jean Luc Nogués, Geltech Inc., (904) 462 2358 | PMMA impregnated porous gel-silica matrices | Commercial pilot plant testing under license. |
| 2303B | Surface Science | DeLong | S. Ray Taylor, University of Virginia (804) 982-5788 | Jim Dante, Wright Lab, (513) 254-0137 and Teresa Simpson, Bethlehem Steel Homer Research Lab, (601) 694-5374, and Ed Colvin, Alcoa Technical Center (412) 337-2550 | Capillary electrophoresis | Adopted approach to occluded site chemistry to understand corrosion in lap splice joints, etc. |
| 2303B | Surface Science | DeLong | David Kanis, Chicago State University, (312) 995-2339 | Ben Thorson and Andrew Hibbs, Quantum Magnetics, (619) 481-7410 | Monolayer assembly methodology | Improving adhesion of packaging materials to high temperature superconductor devices. |
| 2303B | Surface Science | DeLong | Steve Pearton, University of Florida, (352) 846-1086 | Mark Jensen, Honeywell, (612) 954 2625 | Process for dry etching of magnetic materials (NiFe alloys) | High density magnetic recording head arrays used for read-write applications in hard disk drives. |
| 2303B | Surface Science | DeLong | Steve Pearton, University of Florida, (352) 846-1086 | Fan Ren, Lucent Technologies, (908) 582-6902 | Room temperature dry etching technique for Cu | Magnetic devices and Copper (Cu) interconnects in silicon VLSI for chips that have 10,000 or more interconnects. |
| 2303B | Surface Science | DeLong | Steve Pearton, University of Florida, (352) 846-1086 | Randy Shui, Sandia National Labs, (505) 844-6126 | Improved dry etch chemistries for GaN alloys | High temperature electronics/blue light emitters used for applications that endure extreme temperatures. |
| 2303B | Surface Science | DeLong | Steve Pearton, University of Florida, (352) 846-1086 | T.W. Haas, WJMLBM, WPAFB OH, (513) 255-5892 | Patterned GaAs substrates for quantum wire regrowth | Low power electronics/high density memory used in magnetic media. |
| 2303B | Surface Science | DeLong | Steve Pearton, University of Florida, (352) 846-1086 | S.-S. Sun, Planar America, (503) 690-1100 | Etch recipe for high efficiency blue phosphors | Electroluminescent flat panel display arrays used for monitor displays. |
| 2303B | Surface Science | DeLong | F. Sharifi, University of Florida, (352) 846-1086 | R.C. Dynes, UCSD, (619) 534-2919 | Process for lithography on high Tc superconductors | SQUID magnetometers, for possible use in non-destructive evaluation techniques. |
| 2303B | Surface Science | DeLong | F. Sharifi, University of Florida, (352) 846-1086 | M. Paalannen, 35841601, Helsinki University of Technology | Process for nanofabrication of Al tunnel junctions | Coulomb blockage devices for SET transistors for use in circuit boards. |
| 2303B | Surface Science | DeLong | Max Lagally, University of Wisconsin, (608) 263-2078 | Oliver Murphy, Lynntech, (409) 693-0017 | AFM tip coating technology | To be used for examining corrosion for Air Force aircraft. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-----------------|--------|--|--|---|---|
| 2303B | Surface Science | DeLong | Nelson Forster, WL/POS, (513) 255-4347 | Larry Beckworth, Teledyne Ryan Aeronautical, (419) 470-3378 and David Lanman, WL/POT, (513) 255-2767 | Vapor lubrication, bearing material and cage design and material | Vapor lubrication is scheduled for demonstration in Joint Expendable Turbine Engine Concept, Phase II engine. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Ashley Sabin, Hoechst Celanese, (908) 522-7631 | POSS monomer technology | Advanced structural plastics used in heat dissipation for rocket nozzles and flame retardants. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Robert Marshman, Aldrich Chemical Co., (414) 273-3850, ext. 5377 | POSS monomer technology | A new chemical to be added to the R&D catalog of chemicals. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Ed Ellis, Polymer Technologies, (508) 694-1278 | POSS monomer technology | Hard contact lenses for humans. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Kushroo Gandhi, Pilkington Barnes Hind, (408) 991-6362 | POSS monomer technology | Soft contact lenses for humans. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Lt Rich Vaia, WL/MLBP, DSN 785-9184 | POSS monomer technology | Nonlinear Optics (NLO) matrices used for aircraft canopies. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Jeff Gilman, FAA/NIST, (301) 975-6573 | POSS polymer technology | Fire safe plastics for aircraft |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Dave Valia, Pilkington Aerospace Inc., (714) 893-7531, ext. 462 | POSS monomer technology | Nonlinear Optics (NLO) matrices used for aircraft canopies. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Ed Guthrie, Hewlett Packard Co., (302) 633-8641 | POSS polymer technology | High temperature support material used for chromatographic columns. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Robert Miller, IBM, (408) 927-1646 | POSS monomer technology | Lithographic and electronic packaging for chip technology |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Barry Arkles, Gelest, (215) 547-2484 | POSS monomer technology | A new chemical to be added to the R&D catalog of chemicals. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Gary Weber, Dow Corning, (517) 496-5622 | POSS polymer technology | Advanced silicon based composites used in structural materials. |
| 2303B | Surface Science | DeLong | Joseph Lichtenhan, OLAC PL/RKS, (805) 275-5749 | Lloyd Huff, UDRI, (513) 229-3515 | POSS monomer and polymer additive technology | CRDA to supply industry with the materials for many applications |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------|-----|--|--|---|--|
| 2303C | Polymer Chemistry | Lee | Dr Frank Bates, University of Minnesota, (612) 625-6606 | Dr Mark Gehlsen, 3M Corp., (612) 736-5635 | Poly(ethyleneoxide)-poly(alkane) block copolymers | Utilization of the amphiphilic characteristics of the blends in bulk and surface applications. |
| 2303C | Polymer Chemistry | Lee | Dr Frank Bates, University of Minnesota, (612) 625-6607 | Dr Gunilla Gilberg, Kimberly Clark, (770) 587-7384 | Aliquot of poly(ethylene)-poly(dimethylsul oxane) diblock copolymer | Polypropylene surface modifier for material properties tailoring in commercial applications. |
| 2303C | Polymer Chemistry | Lee | Dr Ray Chen, University of Texas at Austin, (512) 471-7035 | Dr Guy Hammer, BMDO, (703) 693-1620 | WD(D)M Devices | High bandwidth audio-video transmission for communications in C4I applications. |
| 2303C | Polymer Chemistry | Lee | Dr Ray Chen, University of Texas at Austin, (512) 471-7035 | Dr R. Leheny, DARPA, (703) 696-2279 | WD(D)M Devices | High performance bit-parallel computer links for advanced optoelectronics. |
| 2303C | Polymer Chemistry | Lee | Dr Ray Chen, University of Texas at Austin, (512) 471-7035 | Dr Chad Noddings, MCC, (512) 338-3769 | WD(D)M Devices | Fast light wave switching for communication networks. |
| 2303C | Polymer Chemistry | Lee | Dr Larry Dalton, University of Southern California, (213) 740-8768 | Michael Salour, TACAN Corporation, (619) 438-1010 | EO materials and associated processing technologies | Development of electro-optical devices for photonic applications in communications. |
| 2303C | Polymer Chemistry | Lee | Dr Larry Dalton, University of Southern California, (213) 740-8769 | John Kenney, ROI Technology, (415) 323-1403 | EO materials and associated processing technologies | Development of electro-optical devices for photonic applications in communications. |
| 2303C | Polymer Chemistry | Lee | Dr Larry Dalton, University of Southern California, (213) 740-8770 | Robert Mustacich, RVM, (805) 964-3368 | EO materials and associated processing technologies | Development of electro-optical devices for photonic applications in communications. |
| 2303C | Polymer Chemistry | Lee | Dr Larry Dalton, University of Southern California, (213) 740-8771 | Deacon Research, Gemfire Corporation, (415) 493-6100 | EO materials and associated processing technologies | Development of electro-optical devices for photonic applications in communications. |
| 2303C | Polymer Chemistry | Lee | Dr Steve Forrest, Princeton, (609) 258-4532 | Dr Vladimir Ban, President, PD-LD Inc., (609) 924-7979 | OVPD process | Production of organic waveguide optical modulators for advanced optoelectronics. |
| 2303C | Polymer Chemistry | Lee | Dr Steve Forrest, Princeton, (609) 258-4532 | Mr Steven Abramson, Universal Display Corp., (610) 617-4010 | OVPD process | Development of display technologies based on organic emitters used for military displays. |
| 2303C | Polymer Chemistry | Lee | Dr Alan Heeger, University of California at Santa Barbara, (805) 893-3184 | Steve Coranieri, Uniax Corp., (805) 562-9293 | Analytical model for the polymer grid triode | BMDO funded SBIR program on polymer grid triode arrays for advanced signal processing. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------|-----|--|--|---|---|
| 2303C | Polymer Chemistry | Lee | Dr Alan Heeger, University of California at Santa Barbara, (805) 893-3184 | Dr Patrick Hood, WL/MLPJ, (513) 255-3808 | Charge transfer induced optical nonlinearity | Materials for sensor and eye protection against laser threat. |
| 2303C | Polymer Chemistry | Lee | Dr Alex Jen, ROI Technologies, (908) 422-3709 | Dr Paul Ashley, Army Redstone Arsenal, (205) 876-7484 | Active Polyimides for EO applications | Development of electro-optical fiber gyro for missile applications. |
| 2303C | Polymer Chemistry | Lee | Dr Alex Jen, ROI Technologies, (908) 422-3709 | Dr Geoffrey Lindsay, Navy China Lake, (619) 939-1630 | Active Polyimides for EO applications | Development of electro-optical fiber gyro for missile applications. |
| 2303C | Polymer Chemistry | Lee | Dr Alex Jen, ROI Technologies, (908) 422-3709 | Dr Richard Lytel, Akzo Nobel Electronics, (408) 752-1801 | High Temperature polyimide passive waveguides | Development of optical thermal switches for communication networks. |
| 2303C | Polymer Chemistry | Lee | Dr Frank Karasz, University of Massachusetts, (413) 545-4783 | M. Chipalkatti, Osram/Sylvania, (508) 750-1578 | Light emitting polymers and blends | Display and lighting technologies for C3I applications. |
| 2303C | Polymer Chemistry | Lee | Dr Frank Karasz, University of Massachusetts, (413) 545-4784 | Ted Kirchner, Foster Miller, (617) 290-0992 | Light emitting polymers and blends | Developing flexible, hemetically sealed light emitting diodes (LEDs) for conformal display applications |
| 2303C | Polymer Chemistry | Lee | Dr Frank Karasz, University of Massachusetts, (413) 545-4785 | Andrew Purdes, Texas Instruments, (214) 995-5559 | Light emitting polymers and blends | Commercial polymer light emitting diodes (LEDs) for flat panel and conformal displays and other applications. |
| 2303C | Polymer Chemistry | Lee | Dr Hilary Lackritz, Purdue University, (415) 493-6100 | Dr John Zetts, WL (513) 255-4474, ext 3212 | EO Measurement during in-situ poling | Development of electro-optical devices for optical signal processing in military photonic applications. |
| 2303C | Polymer Chemistry | Lee | Dr Hilary Lackritz, Purdue University, (415) 493-6100 | Dr Warren Hermann, (301) 342-9114, Naval Air Development Ctr. | EO Measurement during in-situ poling | Development of electro-optical devices for optical signal processing in military photonic applications. |
| 2303C | Polymer Chemistry | Lee | Dr Hilary Lackritz, Purdue University, (415) 493-6100 | Farris Lipscomb, Akzo Nobel, (408) 752-1805 | EO Polymer Poling Dynamics | Fabrication of electro-optical devices for communications |
| 2303C | Polymer Chemistry | Lee | Dr Seth Marder, California Institute of Technology, (818) 395-2829 | Dr Alex Jen, ROI Technologies, (908) 422-3709 | Thiophene containing chromophores | Development of device ready electro-optical polymer systems for advanced optical communications. |
| 2303C | Polymer Chemistry | Lee | Dr Seth Marder, California Institute of Technology, (818) 395-2830 | Dr Chris Ristich, WL/MLPJ, (513) 255-3808 | Phthalocyanine and naphthalocyanine compounds for optical limiting applications | Sensor protection in near infrared range and eye protection in visible range. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------|-----|---|--|---|--|
| 2303C | Polymer Chemistry | Lee | Dr John Pojman, University of Southern Mississippi, (601) 266-5035 | Dr Michael DeRosa, WL/MLPJ, (513) 255-3808 | Optical polymer with gradient NLO dyes | Laser hardening for eye and sensor protection. |
| 2303C | Polymer Chemistry | Lee | Dr John Pojman, University of Southern Mississippi, (601) 266-5035 | Dr Ed Berman, Boston Optical Fiber, (508) 647-4800 | GRIN optical fiber preform | Gradient refractive index (GRIN) optical fiber manufacturing for communication networks. |
| 2303C | Polymer Chemistry | Lee | Dr Paras Prasad, SUNY-Buffalo, (716) 645-6800 | Dr Ryszard Burzynski, Laser Photonics Technologies, (716) 688-8251 | Low optical loss chromophore, APSS | Development of low optical loss electro-optical polymers for photonic applications. |
| 2303C | Polymer Chemistry | Lee | Dr Paras Prasad, SUNY-Buffalo, (716) 645-6801 | Dr Thomas Dougherty, Roswell Park Cancer Institute, (716) 845-8577 | Two-photon photodynamic therapy using efficient two-photon chromophores | Photodynamic therapy for cancer treatment. |
| 2303C | Polymer Chemistry | Lee | Dr Paras Prasad, SUNY-Buffalo, (716) 645-6802 | Technology Transfer Office, Dan Massing, (716) 645-3811 | Multiphasic composites for broad based lasing | Development of advanced laser devices for use in C4I applications. |
| 2303C | Polymer Chemistry | Lee | Dr Paras Prasad, SUNY-Buffalo, (716) 645-6803 | Technology Transfer Office, Dan Massing, (716) 645-3812 | Two-photon 3D optical storage scheme | High density optical data storage for C3I applications. |
| 2303C | Polymer Chemistry | Lee | Dr Paras Prasad, SUNY-Buffalo, (716) 645-6804 | Dr Ryszard Burzynski, Laser Photonics Technologies, (716) 688-8251 | Sol Gel composites photonically active | High density optical data storage for C3I applications. |
| 2303C | Polymer Chemistry | Lee | Dr John Reynolds, University of Florida, (352) 392-9151 | Dr Tom Guarr, Gentex Corporation, (616) 772-1590, ext 434 | Dual color electrochromic devices | Electrochromic devices for auto industry and in aircraft cockpits. |
| 2303C | Polymer Chemistry | Lee | Dr Dan Sandman, University of Mass at Lowell, (508) 934-3835 | Dr Thomas Cooper, WL/MLPJ, (513) 255-3808 | Photochromic molecules | Optical limiting systems for sensor and eye protection. |
| 2303C | Polymer Chemistry | Lee | Dr Charles Spangler, University of Montana, (406) 994-4801 | Mr Robert Goedart, Army TACOM, (313) 574-5444 | Monomers and copolymers optical polymers | SBIR program on sensor/eye protectors in windscreens or goggles. |
| 2303C | Polymer Chemistry | Lee | Dr Charles Spangler, University of Montana, (406) 994-4801 | Dr Ryszard Burzynski, Laser Photonics Technologies, (716) 688-8251 | New multifunctional copolymers with blue electroluminescence | Development of blue emitters for flat panel displays on board aircraft. |
| 2303C | Polymer Chemistry | Lee | Dr Bill Steier, University of Southern California, (213) 740-4415 | Dr W. Bichel, Deacon Research, (415) 493-6100 | Polymer waveguide fabrication technology | Proprietary applications in using active and passive polymer waveguides in display applications. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---------------------------------|---------|---|--|---|---|
| 2303C | Polymer Chemistry | Lee | Dr Bill Steier, University of Southern California, (213) 740-4416 | Dr Y. Shi, TACAN Corp., (619) 438-1010 | Infrared power handling limits of polymer waveguides | Development of electro-optical devices for optical communication networks. |
| 2303C | Polymer Chemistry | Lee | Dr Mrinal Thakur, Auburn University, (334) 844-3326 | Dr Steve Caracci, WL/MLPO, (513) 255-4474 | Single crystal thin films and processing | Voltage sensor on microelectronic chips for advanced electronics. |
| 2303C | Polymer Chemistry | Lee | Dr Mrinal Thakur, Auburn University, (334) 844-3326 | Dr Gary Bjorkland, Optivision Inc., (408) 855-0221 | Single crystal films coated on optical fiber | Organic in-line fiber modulator for high-speed signal processing. |
| 2303C | Polymer Chemistry | Lee | Dr T-S Wu, Hughes Research Laboratory, (310) 317-5901 | Harvey Wagner, Lockheed-Martin, (610) 354-6160 | High birefringence LC molecules | Advanced tunable optical filter for 3-5 micron applications. |
| 2303C | Polymer Chemistry | Lee | Dr T-S Wu, Hughes Research Laboratory, (310) 317-5901 | Dr J. Y. Liu, Macro-Vision Communications, (303) 939-0027 | High birefringence LC molecules | Development of high-speed and high-contrast liquid crystal (LC) modulators for communication applications at 1.5 micron wavelength. |
| 2303D | Chemical Reactivity & Synthesis | Kozumbo | William Bannister, (541) 934-3682, University of Mass. at Lowell | Douglas Nelson, (904) 283-3742, WL/FI, Tyndall AFB, FL | New, non-volatile, low ozone depletion potential (ODP) candidate material | Fire suppression on board aircraft in flight. |
| 2303D | Chemical Reactivity & Synthesis | Roach | David Awaschalom, University of California at Santa Barbara | Ken Babcock, Digital Instruments, Inc. | Submicron current imaging technique using magnetic force spectroscopy | Inspection and characterization of buried conductors for use in integrated electronics for aircraft. |
| 2303D | Chemical Reactivity & Synthesis | Roach | David Awaschalom, University of California at Santa Barbara | Lucien Ghiselin, Digital Instruments, Inc. | Bent 100-nm near-field optical fiber cantilevers for existing atomic force microscopy (AFM) instruments | Room-temperature scanning near-field optical imaging of integrated laser structures for optoelectronics. |
| 2303E | Molecular Dynamics | Berman | Murad, Dressler, Levandier, Williams, PL/GP, (617) 377-3176 | AF SMC-O Kenneth Moe, (310) 363-5697, AFSPACECOM | Measured energy dependence of O2+, NO+, N2+, + Na charge transfer cross sections | Incorporation into code to determine infrared backgrounds and scintillations for DSMP and other satellites. |
| 2303E | Molecular Dynamics | Berman | Murad, Dressler, Levandier, Williams, PL/GP, (617) 377-3176 | AF SMC-O Kenneth Moe, (310) 363-5697, AFSPACECOM | Kinetic data and infrared backgrounds attributable to ions modeled and incorporated into SOCRATES code | Used to determine interactions of spacecraft with surroundings and signatures. |
| 2303E | Molecular Dynamics | Berman | Murad, Dressler, Levandier, Williams, PL/GP, (617) 377-3176 | ESC/TNG - Lt Mat Wojewuczki | SOCRATES code for predicting spacecraft interactions | Used in Project Heat. |
| 2303E | Molecular Dynamics | Berman | Viggiano, Morris, PL/GP, 377-4028 | Naval Strategic Systems Program Office, Carlos Lopez | Boundary layer plasma prediction code results, shock tunnel data | Prediction of plasma levels around reentry vehicles and radio blackout implications. |
| 2303E | Molecular Dynamics | Berman | Viggiano, Morris, PL/GP, 377-4028 | Lockheed-Martin Missiles and Space Corp., Dr J. W. Meyer, (408) 756-7881 | Plasma chemistry reaction rates | Input for plasma prediction codes for reentry blackout and signatures. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|--------------------|--------|--|---|--|--|
| 2303E | Molecular Dynamics | Berman | Viggiano, Morris, PL/GP, (617) 377-4028 | BMDO/AQS, Dr Paul Temple, (703) 604-0357 | Reentry wake phenomenology results and code predictions | Determination of impact of reentry wakes on BMD systems, sensors, algorithms, and architectures. |
| 2303E | Molecular Dynamics | Berman | Ballenthin, Viggiano, Gosselin, Meads, Thorn, PL/GP, (617) 377-4028 | SMC/CL, Launch Programs SPO, Capt B. Laine, Col J. L. Buzzatto; Dr Martin Ross, Aerospace Corp., (310) 336-0360 | Mass spectrometric measurements of chlorine chemistry and ozone depletion in rocket plumes | Determination of Titan IV environmental impact. |
| 2303E | Molecular Dynamics | Berman | Viggiano, Morris, Dotan, PL/GP, (617) 377-4028 | PL/GP, Dr Jack Jasperse, (617) 377-3083, and Dr Dave Anderson | Kinetics of ion-molecule reactions at thermospheric temperatures | Improved accuracy of ionospheric prediction models. |
| 2303E | Molecular Dynamics | Berman | Ballenthin, Miller, Calo, PL/GP, (617) 377-4028 | WL/POSF, Dr Mel Roquemore, (513) 255-6813 | Neutral composition of combustion products from propane/air/halon mixtures | Personnel safety of proposed halon substitute suppressants. |
| 2303E | Molecular Dynamics | Berman | Ballenthin, Miller, Viggiano, PL/GP, (617) 377-4028 | NASA AEAP Program, Dr Brian Toon, (415) 604-5971 | Trace gas composition flight corridors | Environmental impact of civil and military air fleet in upper troposphere. |
| 2303E | Molecular Dynamics | Berman | Katayama, Welsh, Thomas, Dentamaro, PL/GP, (617) 377-5088 | AEDC, Dr Jim Drake, (615) 454-7694 | Collisional quenching rates of molecular excited states | Modeling and measurement of rocket plume optical signatures. |
| 2303E | Molecular Dynamics | Berman | Dr Blumberg, PL/GP, (617) 377-2951 | SMC/MTAX, Capt Dave O'Donnell, (310) 363-0267 | Analysis of laboratory and CIRRS 1A data and IBSS data on IR atmospheric backgrounds | Determination of task statement for SBIRS Phenomenology Exploitation Program. |
| 2303E | Molecular Dynamics | Berman | Dr Blumberg, PL/GP, (617) 377-2951 | BMDQ, MSX Program, Col Bruce Guilmain, (703) 697-4025 | Analysis of laboratory and CIRRS 1A data and IBSS data on IR atmospheric backgrounds | Determination of monthly mission plan for MSX satellite operations. |
| 2303E | Molecular Dynamics | Berman | Dr Blumberg, PL/GP, (617) 377-2951 | Sandia National Laboratory, Dr Duane Landa, (505) 845-8904 | Analysis of visible wavelength backgrounds from transient glows in the mesosphere | Tasking operational satellite data collections. |
| 2303E | Molecular Dynamics | Berman | Dr Blumberg, PL/GP, (617) 377-2951 | Dr Bill Frederick, (703) 693-1836, BMDQ/IR | Analysis of laboratory and CIRRS 1A data and IBSS data on IR atmospheric backgrounds | Determination of IR background predictive code requirements. |
| 2303E | Molecular Dynamics | Berman | Dr Blumberg, PL/GP, (617) 377-2951 | Institute for Defense Analysis, Dr Bill Jeffrey, (703) 845-2136, MSTI-3 Chief Scientist | Analysis of laboratory and CIRRS 1A data and IBSS data on IR atmospheric backgrounds | Determination of mission plan and weekly planning for MSTI-3 satellite operations. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|--------------------|--------|---|---|--|---|
| 2303E | Molecular Dynamics | Berman | Hager, PL/LIDB, (505) 846-0718 | AFMC/Israel Ministry of Defense, Dr S. Shapiro, A. Yagev, Weizmann Institute | Photolytic iodine monobromide 2.7 mm laser | Joint US/Israel project for a solar pumped IBr laser. |
| 2303E | Molecular Dynamics | Berman | Hager, PL/LIDB, (505) 846-0718 | PL/LIDB COIL laser group, Dr Keith Truesdell, (505) 846-5047 | Ringdown spectroscopy of states of O2 | Calibration of yield of O2 (1D) in COIL generator. |
| 2303E | Molecular Dynamics | Berman | Hager, PL/LIDB, (505) 846-0718 | ABL SPO, Capt Jeff Moller, (505) 846-7658; Bill Thompson, (505) 846-2251, PL/LIDB COIL laser group; Dr Keith Truesdell, (505) 846-5047 | Demonstration of mode locking of COIL | Pulsed COIL illuminator for Airborne Laser. |
| 2303E | Molecular Dynamics | Berman | Suri, PL/RKS, (805) 275-5952 | National Cancer Institute, Dr V. L. Narayanan, Chief, Drug Synthesis and Chemistry Branch, (301) 496-8795 | Novel strained ring formate compound | Testing as anti-cancer and anti-AIDS agent. |
| 2303E | Molecular Dynamics | Berman | Suri, PL/RKS, (805) 275-5952 | Morton Thiokol Inc., Dr Robert Wardle, (801) 863-8156 | Synthetic procedure for preparing PGN | Polymer binder for use in solid rocket motors. |
| 2303E | Molecular Dynamics | Berman | Boatz, PL/RKS, (805) 275-5230 | Alliant Techsystems, Dr K. O. Hartman, (304) 726-5114, Technical Director, Insensitive Munitions | GAMESS electronic structure computation program | Computational modeling of energetic compounds. |
| 2303E | Molecular Dynamics | Berman | Petrie, PL/RKS, (805) 275-5759 | PL/RKS, Tom Hawkins, (805) 275-5449 | Novel hydroxyl-ammonium salts of nitroformate and dinitramide | Oxidizers for solution propellants for nonhalogenated propellant systems. |
| 2303E | Molecular Dynamics | Berman | Rodgers, PL/RKS, (805) 275-5623 | NASA Lewis, Bryan Palaszewski, (216) 977-7493 | Candidate HEDM propellants | Fuels and Space Propellants program to develop higher density, higher Isp propellants. |
| 2303E | Molecular Dynamics | Berman | Wucherer, PL/RKS, (805) 275-5759 | TRW, Dave Byers, (310) 814-8848 | Energetic hydrocarbon additives to RP-1 and monopropellant formulations | For use as satellite propellants. |
| 2303E | Molecular Dynamics | Berman | Heaven, Emory University, (217) 333-3574 | ABL SPO, Capt Jeff Moller, (505) 846-7658; PL/LIDB COIL laser group, Dr Keith Truesdell, (505) 846-5047 | Measurement at 150 K of rate constants for determining iodine atom equilibrium | Computer modeling and optimization of COIL laser systems. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|--------------------|--------|---|--|---|---|
| 2303E | Molecular Dynamics | Berman | Davis, Physical Sciences Inc., (508) 689-0003 | ABL SPO, Capt Jeff Moller, (505) 846-7658; PL/LIDB COIL laser group, Dr Keith Truesdell, (505) 846-5047, Charlie Helms | Tunable diode-laser based diagnostic to sensitively monitor H ₂ O, O ₂ (1D), and I* | Accurate measurement of COIL performance parameters and improved of COIL laser operation. |
| 2303E | Molecular Dynamics | Berman | Davis, Physical Sciences Inc., (508) 689-0003 | AFMC/Israel Ministry of Defense, Dr S. Shapiro, A. Yogeve, Weizmann Institute | Tunable diodes to sensitively monitor H ₂ O, O ₂ (1D), and I* | Accurate measurement of COIL performance parameters and improved of COIL laser operation. |
| 2303E | Molecular Dynamics | Berman | Davis, Physical Sciences Inc., (508) 689-0003 | Dr Willy Bonn, DLR, 011-49-711-686272 | Diode laser based diagnostic for water vapor | Improved development and scaling of COIL laser. |
| 2303E | Molecular Dynamics | Berman | Davis, Physical Sciences Inc., (508) 689-0003 | AFMC/Israel Ministry of Defense, Dr Z. Rosenwaks, Ben Gurion University, 972-7-6278994 | Tunable diode-laser based diagnostic to sensitively monitor H ₂ O, O ₂ (1D), and I* | Accurate measurement of COIL performance parameters and improved of COIL laser operation. |
| 2303E | Molecular Dynamics | Berman | Davis, Physical Sciences Inc., (508) 689-0003 | AEDC, Kevin Zysk, (615) 454-6507 | High-temperature diagnostic for detecting water vapor | Diagnostic of wind tunnel performance and flow visualization. |
| 2303E | Molecular Dynamics | Berman | Davis, Physical Sciences Inc., (508) 689-0003 | NASA Langley, John Barrick, (757) 864-5831 | Diode-based sensitive diagnostic for water vapor | Used in system to determine the mixing between the stratosphere and troposphere. |
| 2303E | Molecular Dynamics | Berman | Davis, Physical Sciences Inc., (508) 689-0003 | Dr Bill McDermot, Rocketdyne, Charlie Clendening, TRW, (818) 586-4182 | Tunable diode-laser based diagnostic to sensitively monitor H ₂ O, O ₂ (1D), and I* | Accurate measurement of COIL performance parameters and improved of COIL laser operation. |
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | Dr Michael McClendon, Hewlett-Packard, (707) 577-3482 | Infrared spectroscopic methods and methods for handling isotopes | In situ calibration standard for optical spectrum analyzers. |
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | Dr Daniel Oh, (505) 984-1322, Southwest Sciences Inc. | Precise determination of OH dipole moment function | Developing methods to monitor OH in the troposphere. |
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | Dr Robert Curti, (713) 527-4816, Rice University | Precise determination of OH dipole moment function | Controlling smogstack pollution by monitoring OH and reducing NOx with thermal de-NOx process |
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | Appleton Research Laboratory, Dr John Ballard | Determination of radiative lifetime of O ₂ (1D) | Atmospheric transmission in the infrared at 1.3 mm. |
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | PL/LIDB, Harold Miller, (805) 853-3286 | Determination of radiative lifetime of O ₂ (1D) | Calibration of O ₂ (1D) generators for COIL devices. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|--------------------|--------|--|---|--|--|
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | Marlowe Engineering, Greg Jewitt, (303) 443-4321 | Sensitive infrared spectroscopic methods | Measurement of water vapor in high-efficiency hydrogen-oxygen combustion systems. |
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | Dr Warren Wiscombe, (301) 286-8499, NASA Goddard | Binding energies and spectroscopy of small clusters of water molecules | Determination of the infrared opacity of the atmosphere (infrared transmission). |
| 2303E | Molecular Dynamics | Berman | Nesbitt, University of Colorado, (303) 492-8857 | Mike Lang, (303) 550-7785, Environmental Optical Sensors, Inc. | Spectroscopic data on vibrational overtones | HCN gas reference cells for calibration of optical devices. |
| 2303E | Molecular Dynamics | Berman | Oka, University of Chicago, (312) 702-7070 | Dr Tom Anthony, (518) 387-6160, General Electric | Low temperature spectroscopy of solids | Spectroscopy of isotopically pure diamond for high thermal conductivity materials. |
| 2303E | Molecular Dynamics | Berman | Field, MIT Lincoln Laboratory, (617) 253-1489 | Dr Steven Lipson, (617) 377-7380, PL/GPOS | Spectroscopic methods to determine mechanisms of formation of observed NO distributions | Model of NO emissions in the atmosphere for determining infrared backgrounds for surveillance systems. |
| 2303E | Molecular Dynamics | Berman | Field, MIT Lincoln Laboratory, (617) 253-1489 | Dr Steven Davis, (508) 689-0003, Physical Sciences Inc. | Techniques to monitor vibrationally excited iodine molecules | Development of optically pumped lasers for countermeasures and other applications. |
| 2303E | Molecular Dynamics | Berman | Whitefield, University of Missouri-Rolla, (314) 341-4340 | SMC/CL, Launch Programs SPO, Capt B. Laine, Col J. L. Buzzatto; Dr Martin Ross, Aerospace Corp., (310) 336-0360 | Determination of particulate size distribution in exhaust of Titan IV solid rocket motors | Determination of Titan IV environmental impact. |
| 2303E | Molecular Dynamics | Berman | Whitefield, University of Missouri-Rolla, (314) 341-4340 | WL/PO, M. Roquemore, (513) 255-6813, Bill Harrison, Capt Barry Kiel, McDonnell Douglas, Glenn Harper | Determination of particulate size distribution and composition in jet exhaust using new fuel additives | Test of effectiveness of novel JP8 + 100 fuel to improve performance of old jet engines. |
| 2303E | Molecular Dynamics | Berman | Copeland, SRI International, (415) 326-6534 | Joe Marshall, Joan Pallix, (650) 604-0332, Eloret Corp. | O-atom detection and ozone handling methods | Analysis of degradation of waterproofing agents on spacecraft materials. |
| 2303E | Molecular Dynamics | Berman | Minton, Montana State University, (406) 994-5394 | Dr Ranty Liang, (818) 354-6314, Jet Propulsion Laboratory | Protocol for atomic oxygen testing of materials in ground-based facilities | Assessment of degradation of materials to be used in space, on spacecraft and satellites. |
| 2303E | Molecular Dynamics | Berman | Zewail, Caltech, (818) 395-6536 | Dr Jack Syage, (310) 336-1583, Aerospace Corp. | Reactivity, properties, and dynamics of atmospheric cluster ions | Assessment of impact of jet and rocket exhaust on the atmosphere. |
| 2303E | Molecular Dynamics | Berman | Zewail, Caltech, (818) 395-6536 | Dr Terry Cole, (818) 354-5458, Jet Propulsion Laboratory | Damage limits of CCD detectors | CCD detectors for use in satellites and spacecraft. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-----------------------|--------|---|--|--|--|
| 2303E | Molecular Dynamics | Berman | Diott, University of Illinois, (217) 333-3574 | Dr Robert Sciciliano, (607) 774-3333, Aniltec, Inc. | Use of explosive films in polymer layer to facilitate laser ablation | Method for using lasers for direct computer-to-printing plate transfer imaging. |
| 2303E | Molecular Dynamics | Berman | Diott, University of Illinois, (217) 333-3574 | Dr Jim Jonza and Dr Dwayne Labrake, 3M, Inc., (512) 984-5406 | Laser shock wave generation and diagnostics | Use in manufacturing printed circuit boards. |
| 2303E | Molecular Dynamics | Berman | Casassa, NIST, (301) 975-2371 | Ed Murad, PL/GP, (617) 377-3176 | OH state distributions from O + H2O reaction | Modeling of exhaust plumes and locating projectiles based on extent of IR plume. |
| 2303E | Molecular Dynamics | Berman | Casassa, NIST, (301) 975-2371 | Robert Hinebaugh, (614) 522-7990, (for BMDO), AF Aerospace Guidance and Metrology Center | Spectroscopic (REMPI) measurements on water | Low pressure water measurement standards. |
| 2303E | Molecular Dynamics | Berman | Casassa, NIST, (301) 975-2371 | Robert Hinebaugh, (614) 522-7990, (for BMDO), AF Aerospace Guidance and Metrology Center | Spectroscopic methods for wind tunnel tests | Identification of contaminant species in weapons testing environment. |
| 2303E | Molecular Dynamics | Berman | Casassa, NIST, (301) 975-2371 | Dave Crosley, (415) 859-2395, SRI International | OH state distributions from O + H2O reaction | Analysis of LIDAR measurements of tropospheric OH for interpreting ozone concentrations. |
| 2303E | Molecular Dynamics | Berman | Bowers, University of California at Santa Barbara, (805) 893-2893 | Dr Jim Scriven, 011-44-1642-432287, ICI Polymers | Mass spectroscopic method of determining size distribution of chains in polymers | Control of production and properties of polymers. |
| 2303E | Molecular Dynamics | Berman | Wittig, Reiser, USC (213) 740-7368 | Dr Chris Capellos, (201) 724-3550, ARDEC | Gas-phase and gas-surface collision energy transfer rates | Models of combustion in gun propellants. |
| 2303E | Molecular Dynamics | Berman | Benard, Rockwell International, (805) 373-4278 | Robert Ondercin, (937) 255-4474, ext. 3211, WL/ML | Use of azides to produce carbon nitride films | Optically transmitting, abrasion resistant material for IR windows on domes on weapons and aircraft. |
| 2303F | Theoretical Chemistry | Berman | Kalia, Louisiana State University, (504) 388-1342 | Dr Jeremy Broughton, (202) 767-4069, Naval Research Laboratory | Interatomic potentials for various polymorphs of silica, and interaction potentials for crystalline quartz | Simulations of long time transients in quartz crystal accelerometers. |
| 2303F | Theoretical Chemistry | Berman | Kalia, Louisiana State University, (504) 388-1342 | Dr James Patterson, (206) 865-3683, Boeing Corp. | Implementation of Fast Multipole Method | Parallel implementation of electromagnetic scattering calculations for simulating aircraft radar cross sections. |
| 2303F | Theoretical Chemistry | Berman | Rabitz, Princeton University, (609) 258-3917 | Dr Paul Saxe, (619) 546-5509, Biosym Technologies Inc. | Sensitivity analysis tools that show how potential surface features influence molecular structural observables | Commercial software package for molecular modeling for biostructural applications. |
| 2303F | Theoretical Chemistry | Berman | Alexander, University of Maryland, (301) 405-1823 | Dr Byron Lengsfeld, IBM, (408) 927-2032 | Genetic algorithm minimization routine | Incorporated into "Mulliken" statistical mechanics program. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-----------------------|--------|---|---|---|--|
| 2303F | Theoretical Chemistry | Berman | Pulay, University of Arkansas, (501) 575-4601 | Dr Benny Johnson, (412) 828-7106, Q-Chem, Inc. | Redundant Coordinate Geometry Optimization Method | Incorporated into quantum chemistry software package. |
| 2303F | Theoretical Chemistry | Berman | Pulay, University of Arkansas, (501) 575-4601 | Pacific Northwest National Laboratory, Dr Bruce Garrett, (509) 375-2587 | Redundant Coordinate Geometry Optimization Method | Incorporated into quantum chemistry software package. |
| 2303F | Theoretical Chemistry | Berman | Carter, UCLA, (310) 206-5118 | Dr Michael Gardos, (310) 616-9890, Hughes Electro-Optical Systems | Calculations to determine the mechanism of hydrogen adsorption and desorption on silicon surfaces | Friction and wear of silicon surfaces for MEMS applications. |
| 2303F | Theoretical Chemistry | Berman | Scuseria, Rice University, (713) 527-4746 | Dr Mike Frisch, (412) 279-6700, Gaussian, Inc. | Gaussian very Fast Multipole Method | Incorporated into leading quantum chemistry software package for improved scaling of calculations on large systems. |
| 2303F | Theoretical Chemistry | Berman | Schaefer, University of Georgia, (706) 542-2067 | Dr Tom Miller, (617) 377-4028, PL/GPID | Electron affinity and energetics calculated for a full series of fluorine-containing radicals | Used in WAKE code for predicting electron densities (and radar cross sections) in reentry plasmas containing teflon. |
| 2303F | Theoretical Chemistry | Berman | Voth, University of Pennsylvania, (215) 898-3048 | Capt Scott Wierschke, (805) 275-5334, DOD High Performance Computing Centers | Centroid Molecular Dynamics code | Available to DoD users for treating dynamics problems that include tunneling. |
| 2303F | Theoretical Chemistry | Berman | Gordon, Iowa State, (515) 294-0452 | Capt Scott Wierschke, (805) 275-5334, DOD High Performance Computing Centers | MacMolPlt graphical user interface | Visualization of molecules, reaction paths from electronic structure calculations. |
| 2303F | Theoretical Chemistry | Berman | Gordon, Iowa State, (515) 294-0452 | Apple Computers, Scott Jenkins, Chris Nebel, (408) 974-5211 | GAMESS program for the Macintosh platform | Inexpensive and accessible method for electronic structure calculations and educational purposes. |
| 2303F | Theoretical Chemistry | Berman | Gordon, Iowa State, (515) 294-0452 | Dr Walter Stevens, (301) 975-5968, NIST | Effective fragment method for calculating effects of solvation | Used to mimic enzyme-substrate interactions. |
| 2303F | Theoretical Chemistry | Berman | Morokuma, Emory University, (404) 727-2180 | Dr Ed Murad, (617) 377-3176, PL/GP | Potential energy surfaces for reactions involving H, N, C, and O | Analysis of contribution of isomers of HNCO to rocket plume emissions. |
| 2303F | Theoretical Chemistry | Berman | Yarkony, Johns Hopkins University, (410) 516-4663 | Dr G. Hager and Dr Robert Coombe, (303) 871-2436, University of Denver, PL/LI | Calculation of radiative lifetime of NCI (a) | Assessment of potential NCI-I* laser system. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---------------------------|---------|---|---|---|---|
| 2303F | Theoretical Chemistry | Berman | Weare, University of California at San Diego, (619) 534-3286 | Dr Todd Yates, (937) 255-9138, WJML | Parallel versions of Ab Initio Molecular Dynamics code | Calculation of properties of large chain polymers. |
| 2303F | Theoretical Chemistry | Berman | Weare, University of California at San Diego, (619) 534-3286 | Dr Steve Ashby and Dr Scott Kohn, Lawrence Livermore National Lab, (510) 423-2462 | Parallel development of adaptive mesh solutions to partial differential equations | Improved grids for CFD calculations, quantum materials calculations, and ground water flow. |
| 2303F | Theoretical Chemistry | Berman | Levine, Hebrew, U972-2-658-5260 | Dr J. Murdoch, (216) 441-4100, General Electric | Algorithm for determination of a distribution of maximum entropy | Image enhancement of x-rays enabling lower dosages to be used in breast cancer screening. |
| 2303F | Theoretical Chemistry | Berman | Bartlett, University of Florida, (352) 392-1597 | Dr S. Ambadi, Motorola, (602) 655-4040 | ACES II code for calculation of energetics of transient plasma species | Design of materials for plasma etching of semiconductors. |
| 2303F | Theoretical Chemistry | Berman | Bartlett, University of Florida, (352) 392-1598 | Dr Karl Christie, (805) 275-5194, Hughes STX | Predicted structure of trinitrotriazine | Synthesis of new high energy molecule. |
| 2303F | Theoretical Chemistry | Berman | Bartlett, University of Florida, (352) 392-1599 | Loker Hydrocarbon Institute, Dr George Olah, (213) 740-5976 | Method for calculation of coupling constants incorporated in ACES II code | Assignment of NMR spectra of carbocations. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Johnathan Kiel, AL/OERT, Brooks AFB, TX, (210) 536-3583 | American Type Culture Collection, Bobbie Brandon, (301) 881-2600, Head ATCC Patent Depository | Two mouse mammary tumor cell lines were genetically engineered that produce diacyluminomelanin & nitric oxide synthetase activity without dying | Cell lines were deposited for use by scientists interested in studying radiofrequency effects on tumor cell growth. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Jim Spain, AL/EQC, Tyndall AFB, FL, (904) 283-6058 | US Army Corps of Engineers, Waterways Experiment Station, MI, Herb Fredrickson, (601) 634-3716 | Novel pathways for the degradation of nitroaromatic compounds were discovered and elucidated in bacterial strains | Information is for use in developing biotechnology for the safe destruction of explosives. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Jim Spain, AL/EQC, Tyndall AFB, FL, (904) 283-6059 | ICI, Inc. Sid Saunders, (423) 856-7250; also, the National Test Site Director Alison Thomas, (904) 283-6303 | Novel pathways for the degradation of dinitrotoluene were discovered and elucidated in bacterial strains | Information is for use in developing biotechnology to remediate nitro-based explosives in groundwater. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Benjamin Rockwell, Armstrong Lab, AL/OEDL, Brooks AFB, TX (210) 536-4790 | American National Standard Institute (ANSI), Dr Wolbarsht, (919) 660-5670 | New damage mechanisms were determined for retinal damage induced by laser pulses shorter than several nanoseconds | Information will help establish new laser safety standards, i.e., the maximum permissible exposure (MPE) limits of ultrashort laser pulses. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---------------------------|---------|---|--|--|---|
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Benjamin Rockwell, Armstrong Lab, AL/OEDL, Brooks AFB, TX (210) 536-4790 | Am. Conf. of Govt & Industrial Hygienists (ACGIH), Dave Sliney, (410) 671-3932 | New damage mechanisms were determined for retinal damage induced by laser pulses shorter than several nanoseconds | Information will help establish new laser safety standards, i.e., the maximum permissible exposure (MPE) limits of ultrashort laser pulses. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | Dupont, Newark, DE; Scott Cunningham; (302) 451-9138 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | Roger Melton, Exxon, Houston, TX, (713) 965-4373 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | Neta Hercyk, Conoco, Ponca City, OK, (405) 767-4182 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | Arthur Stewart, Oak Ridge National Laboratory, Oak Ridge, TN, (423) 574-7835 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | Sara McMillen, Chevron, San Francisco, CA, (510) 242-3485 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | Dr David Nakles, Retec, Monroeville, PA, (412) 380-0140 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | Bruce Krewinghaus, Shell, Houston, TX, FAX (713) 544-8727 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Martin Alexander, Cornell University, Ithaca, NY, (607) 255-1717 | John Smith, Alcoa, Pittsburgh, PA, (412) 337-5432 | Data was acquired indicating the bioavailability and toxicity of aging soil contaminants | Information will be used to establish environmental endpoints and health risks for decontaminating military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Rajesh Mehra, University of CA at Riverside, (909) 787-6473 | University of California Toxic Substances Research and Teaching Program, Director's Office, UC-Davis, (916) 752-2097 | Technical information was acquired enabling the development of synthetic genes for phytoremediation | Results will help develop biotechnology to remediate contaminated sites on military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Rajesh Mehra, University of CA at Riverside, (909) 787-6473 | Dr Graham Bench, Lawrence Livermore National Laboratory, (510) 423-5155 | Mutant yeast strain was developed that resists cadmium toxicity due to intracellular formation of cadmium sulfite crystallites | Results will help develop biotechnology to remediate contaminated sites on military bases. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---------------------------|---------|---|--|--|--|
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Robert Lochmiller, Oklahoma State University, Stillwater, OK, (405) 744-9672 | U. S. Fish and Wildlife Service, Tulsa, OK, Todd Adornato, (918) 581-7572 | Information was acquired on the pathological effects in animals inhabiting contaminated sites | Data will be used in the preparation of guidelines for post-remediation monitoring of toxic waste sites on military bases. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Richard Guy, University of California at San Francisco, (415) 476-4830 | Dr Robert Zendzian, (703) 305-5495, US Environmental Protection Agency, Office of Pesticide Programs | Database was developed for the derivation of algorithms for predicting skin absorption of toxic chemicals | Database will be used by EPA in predicting national safety standards for dermal exposure to toxic chemicals of interest to the Air Force. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Gerben Zylstra, Rutgers University, New Brunswick, NJ, (908) 932-8165, x320 | Dr Rob Steffan, Envirogen, Inc., (609) 936-9300 | Clones and gene sequences were established for the degradation of p-nitrobenzoate | Results will help in developing diagnostic probes to assess contaminated sites for presence of specific organisms that degrade nitroaromatic compounds of military importance. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Gerben Zylstra, Rutgers University, New Brunswick, NJ, (908) 932-8165, x320 | Dr Rob Steffan, Envirogen, Inc., (609) 936-9300 | Clones and gene sequences were established for the degradation of p-nitrophenol | Results will help in developing diagnostic probes to assess contaminated sites for presence of specific organisms that degrade nitroaromatic compounds of military importance. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Gerben Zylstra, Rutgers University, New Brunswick, NJ, (908) 932-8165, x320 | Dr Rob Steffan, Envirogen, Inc., (609) 936-9300 | Clones were established for degrading p-nitrophenol from Envirogen's bacterial strain P. Fluorescens ENV2030 | Clones will be tested for use in commercial remediation of nitroaromatic compounds. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Gerben Zylstra, Rutgers University, New Brunswick, NJ, (908) 932-8165, x320 | National Center for Biotechnology Information, Bethesda, MD, Leigh A. Riley, (301) 496-2475 | Gene and protein sequences were determined for the degradative enzyme p-nitrophenol monooxygenase | Molecular sequences were added to the GenBank Database for use by other researchers investigating mechanisms to biodegrade nitroaromatic compounds of military importance. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Gerben Zylstra, Rutgers University, New Brunswick, NJ, (908) 932-8165, x320 | National Center for Biotechnology Information, Bethesda, MD, Leigh A. Riley, (301) 496-2475 | Gene and protein sequences were determined for the degradative enzymes p-nitrobenzoate reductase and hydroxylaminolase | Molecular sequences were added to the GenBank Database for use by other researchers investigating mechanisms to biodegrade nitroaromatic compounds of military importance. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr David T. Gibson, University of Iowa, Iowa City, IA, (319) 335-7980 | National Center for Biotechnology Information, Bethesda, MD, Leigh A. Riley, (301) 496-2476 | Gene and protein sequences were determined for the degradative enzyme 2-nitrotoluene dioxygenase | Molecular sequences were added to the GenBank Database for use by other researchers investigating mechanisms to biodegrade nitroaromatic compounds of military importance. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr David T. Gibson, University of Iowa, Iowa City, IA, (319) 335-7980 | Dr Domenic Paone, Sybron Chemicals, Roanoke, VA 1-800-859-2972 | Genes for the 2-nitrotoluene dioxygenase enzyme were cloned from a bacterial strain | Results will improve the biodegradation of complex mixtures of nitroaromatic compounds of military importance. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr David T. Gibson, University of Iowa, Iowa City, IA, (319) 335-7980 | Dr Jim Spain, AL/EEC, Tyndall AFB, FL, (904) 283-6058 | Genes for the 2-nitrotoluene dioxygenase enzyme were cloned from a bacterial strain | Clones will be used in biodegradation and bioremediation studies with various aromatic and nitroaromatic compounds of military importance. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-----------------------------------|---------|--|--|---|--|
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Cynthia A. Toth, Duke University Eye Center, (919) 684-5631 | Dr Dave Sliney, Am. Conf. of Govt & Industrial Hygienists (ACGIH), (410) 671-3932 | First histopathologic evidence is produced in retina that documents minimal level of pathologic response to ultrashort laser pulses | Data will be used to establish national laser safety standards, i.e., the maximal permissible exposure limits for ultrashort laser pulses. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Cynthia A. Toth, Duke University Eye Center, (919) 684-5631 | Dr Dave Sliney, Am. Conf. of Govt & Industrial Hygienists (ACGIH), (410) 671-3932 | First histopathologic evidence is produced of full thickness retinal damage from ultrashort laser pulses at relatively low energies | Data will be essential in establishing national laser safety standards for ultrashort laser pulses. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Drs Mark Witten, (520) 626-2610 and Dave Harris (520) 621-6271, University of Arizona, Tucson, AZ | Merck and Co., Inc. Dr Greg Wiederrecht (908) 594-6576 | Substance-P protects the lung and immune system from damage by jet fuel | Substance-P will be tested as an immune stimulant and vaccine adjuvant to protect against chemically induced immune suppression. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Drs Mark Witten, (520) 626-2610 and Dave Harris (520) 621-6271, University of Arizona, Tucson, AZ | Glaxo Wellcome, Hertfordshire, United Kingdom, Dr J.N. McDonald, (44 (0) 1-438-745745) | Substance-P protects the lung and immune system from damage by jet fuel | Substance-P will be tested as an immune stimulant and vaccine adjuvant to protect against chemically induced immune suppression. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Drs Mark Witten, (520) 626-2610 and Dave Harris, (520) 621-6271, University of Arizona, Tucson, AZ | SciClone, Inc., Dr Tom Moore, (415) 949-5559 | Substance-P protects the lung and immune system from damage by jet fuel | Substance-P will be tested as an immune stimulant and vaccine adjuvant to protect against chemically induced immune suppression. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Frank Witzmann, Indiana Univ-Purdue University, Columbus, IN 47203, (812) 348-7215 | Dr Ray Grant, Proctor & Gamble Co., Cincinnati, OH, (513) 627-2179 | Techniques were developed for large-scale two-dimensional protein electrophoresis and image analysis | Biotechnology will be used to research and develop drugs, pharmaceutical products and biological modifiers. |
| 2312A | Bioenvironmental Sciences | Kozumbo | Dr Frank Witzmann, Indiana Univ-Purdue University, Columbus, IN 47203, (812) 348-7215 | Dr N. Leigh Anderson, Large Scale Biology Corp., Rockville, MD, (301) 424-5989 | Proteins were identified on two-dimensional electrophoretic maps | Data were added to the Tissue Effects Database under development at Large Scale Biology Corporation. |
| 2312C | Chronobiology & Neural Adaptation | Haddad | Dr David Dinges, University of Penn. (215) 898-9949 | F-117 Squadron, Holloman AFB, Lt Col Lex Brown, (505) 475-5927 | Knowledge of the circadian system effects on vision | Night vision goggle use, and scheduling of night operations. |
| 2312C | Chronobiology & Neural Adaptation | Haddad | Dr Greg Sutcliffe, Scripps Research Institute, (619) 784-8064 | Digital Gene Technologies, Karl Hasel, (619) 552-1400 | New method to automate gene expression | Used for medical diagnosis. |
| 2313B | Perception & Cognition | Tangney | Dr Shute, Armstrong Laboratory, AL/HRT (210) 671-2734 | Mr John Schuler, (210) 536-2034, Naval Post-Graduate Research and Development Ctr. | SMART, a model of student learning | Educational software for training of Navy sonar specialists. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|------------------------|---------|---|--|--|---|
| 2313B | Perception & Cognition | Tangney | Dr Wesley Regian, Armstrong Laboratory, AL/HRT (210) 536-2034 | Harvey Pantzis, (408) 373-0728, Brooks & Cole Publishers | Method for intelligent tutoring | IntelliTutor (TM) educational software for mid-level algebra, adaptable to AF technical training curricula. |
| 2313B | Perception & Cognition | Tangney | Dr Martin Regan, York University, (416) 736-5627 | Dr Wray, (617) 726-5537, Harvard Medical School | Tests of visual sensitivity to motion and texture. | Quality metric for flight simulation visuals; ophthalmologic screen for multiple sclerosis. |
| 2313B | Perception & Cognition | Tangney | Dr Wolfe, Brigham and Women's College, (617) 732-7841 | Dr Krebs, (408) 656-2543, Naval Post Graduate Research & Development Ctr. | Model of human visual attention | Evaluation of sensor fusion in false coloration of night vision displays. |
| 2304A | Dynamics & Control | Jacobs | Prof A. Krener, University of California at Davis, (916) 752-3185 | Dr Mark Myers, UTRC, Hartford, CT, (860) 727-7499 | Bifurcation analysis tools and nonlinear controller design | Discovery of new stall precursor for use in feedback control in compressors. |
| 2304A | Dynamics & Control | Jacobs | Prof J. Speyer, UCLA, (310) 206-4451 | Applied Physics Laboratory, Laurel MD, (301) 953-6000, ext. 7605 | New adaptive, robust, nonlinear estimator based upon universal linearization of spherical measurements in rectangular coordinates, kinematic pseudo-measurements, new circular target models, and enhanced filter robustness based on a dissipative inequality | Enhance performance of standard Navy missile. Robust terminal guidance laws to include new target models, random refraction slope, etc. |
| 2304A | Dynamics & Control | Jacobs | Prof L. Watson, Virginia Tech., (540) 231-7540 | Dr Mark Myers, UTRC, Hartford, CT, (860) 727-7499 | Homotopy algorithms and mathematical software | Bifurcation analysis of turbomachinery models. |
| 2304A | Dynamics & Control | Jacobs | Profs E. Tracy and R. Brown, William and Mary (757) 221-3527 | Dr R. Burne, Allied Signal, Columbia, MD, (410) 964-4159 | New strategies for using symbol statistics to detect transitions in complex systems, e.g., noise driven turbulent flows | Early detection of rotating stall in turbines. |
| 2304A | Dynamics & Control | Jacobs | Dr Harry Klopff, WL/AAC, (513) 255-7649 | Dr Jim Morgan, WL 6.2 Program with Draper Lab., (513) 255-7650 Year one of a three-year contract | New residual gradient reinforcement learning algorithms | Improve filtering for GPS-INS sensor fusion problems. |
| 2304A | Dynamics & Control | Jacobs | Prof M. Krstic, University of Maryland, (301) 405-5206 | Dr Mark Myers, UTRC, Hartford, CT, (860) 727-7499 | New adaptive nonlinear backstepping control design methodology | New control laws for stabilizing compressor rotating stall and surge are being evaluated experimentally on UTRC test rigs. |
| 2304A | Dynamics & Control | Jacobs | Prof J. Tsitsiklis, MIT, jnt@athena.mit.edu | Dr Volker Tresp, 49-89-636-46310, Siemens, tresp@traun.zfe.siemens.de | Neurodynamic programming techniques | NDP techniques are applied to train and optimize feedback policies for administration and routing in ATM (asynchronous transfer mode) communication network, including the possibility of incorporating these methods in commercial ATM switches. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|--------------------|--------|---|--|--|--|
| 2304A | Dynamics & Control | Jacobs | Prof M. Dahleh, MIT, (617) 253-3892 dahleh@lids.mit.edu | Dr Dragan Obradovic, 49-89-636-49499, Siemens, obrad@sava.zfe.siemens.de | Identification and control of nonlinear systems | Detection of tumors from EEG signals. |
| 2304A | Dynamics & Control | Jacobs | Profs A. Laub and C. Kennedy, University of California at Santa Barbara, (805) 893-3616, cofund with Maj Schreck | Jim Huang, (617) 273-3388, Alphatech, Inc., Burlington, MA, jim.huang@alphatech.com | New algorithms for conditioning and statistical condition estimation | Sensitivity of optical flow calculations for automatic target recognition and image processing. |
| 2304A | Dynamics & Control | Jacobs | Prof W. Rugh, Johns Hopkins University, (410) 516-7004 | Paul Jackson, Applied Physics Laboratory, Laurel, MD, (410) 792-5000, ext. 8093 | Gain scheduling: theory of hidden coupling terms and their avoidance | Evaluation of reduced-rate gain updating and hidden coupling terms in digital implementation of continuous time scheduled autopilot for STANDARD Missile-2 Block IVA upgrade. |
| 2304A | Dynamics & Control | Jacobs | Prof A. Laub, University of California at Santa Barbara, (805) 893-3616, cofund with Major Schreck | Kevin Shortelle, (904) 371-8035, System Dynamics International, Gainesville, FL, sdi@afn.org | Fast algorithms and software for the solution of algebraic Riccati equations | Investigate benefits of new nonlinear estimation techniques for improving the accuracy of integrated navigation systems for the Air Force. |
| 2304A | Dynamics & Control | Jacobs | Prof Allen Tannenbaum, University of Minnesota, (612) 625-6395 | Dr Sal Cusumano, Phillips Laboratory, Kirtland AFB, NM, (505) 846-0463 | Mathematical algorithms and software for image enhancement and smoothing (based on nonlinear invariant flow equations) | Software installed to examine efficacy of methodology for ABL tracking problems. |
| 2304A | Dynamics & Control | Jacobs | Prof Allen Tannenbaum, University of Minnesota, (612) 625-6395 | Steve Floeder, 3M Corporation, Minneapolis, MN, (612) 733-1015 | Mathematical algorithms and software for image enhancement and smoothing (based on nonlinear invariant flow equations); new "snake" algorithm | Tools are being used for the purposes of enhancement smoothing, denoising, segmentation, shape recognition. Snake algorithms are used by 3M for visual inspection of defects in chemical webs. |
| 2304A | Dynamics & Control | Jacobs | Dr M. Elgersma, Honeywell Technology Center, Minneapolis, MN, (612) 951-7208 | Paul Samanant, Honeywell Technology Center, Minneapolis, MN, (612) 951-7270 | Real-time 3D Min-Max pursuit evader algorithms | Hardware-in-the loop simulation using Intel i80960 processor in Honeywell Inertial Flight Management Unit (IFMU). Miniature IFMU is small enough for UAVs and missiles. |
| 2304A | Dynamics & Control | Jacobs | Prof. Bill Perkins, Univ. of Illinois, (217) 333-0283, Prof. Juraj Medanic, University of Illinois at Urbana, (217) 333-0283, Wise, MDA, St Louis, (314) 232-4549 | Pete Wise, (904) 882-2961, ext. 3337, AFDTC/MNAG, USAF, Eglin AFB, FL | Projective control/optimal control algorithms and software for designing simplified low order controllers which can perform at near optimal levels | Algorithms inserted in AUTOGAIN control design software and used in design of GNC system in Miniaturized Munition Technology (MMT) program. New approach saves hardware on 250 lb. bomb with hit-to-kill accuracy that can penetrate 8 ft. concrete. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---|---------|--|---|--|--|
| 2304A | Dynamics & Control | Jacobs | Dr K. Wise, MDA, St Louis, (314) 232-4549 | Kevin Citurs, MDA, St Louis and NASA Dryden, (314) 232-3918 | New algorithms and software for analyzing robustness and calculating exact stability margins for real parameter uncertainty | Algorithms inserted in ROBUSTR software package and used in the X-36 program (small tailless UAV) to analyze flight control sensitivity to uncertainties in the aerodynamic coefficients. |
| 2304B | Physical Mathematics & Applied Analysis | Nachman | Dr John Maddocks Math U Md College Park MD 20742 (301) 405-7641 | Dr Carlos Padilla Moldyn, Inc. 955 Mass. Ave Cambridge MA 02139 (617) 354-3124 | Upgraded modern continuum mechanics by the invention of the Impetus-Striction Method and applied this to nonstandard Hamiltonian description of flexible molecular chains | Moldyn seeks to predict the dynamics of certain long, complex molecules which are key ingredients of laser protection visors contemplated by VL and for which VL awarded Moldyn an SBIR Phase II. |
| 2304B | Physical Mathematics & Applied Analysis | Nachman | Dr William Kath Applied Math Northwestern Evanston IL 60208 (847) 491-8784 | Mr Donald Sipes VP of Technology ATx Telecom Inc 1251 Frontenac Rd Naperville IL 60563 (630) 369-4299 | Nonlinear Schrodinger equation (NLS) model derived and interrogated as descriptor of soliton pulses in optical fibers | Tailoring of various fiber parameters and optimization of fiber segment lengths were obtained from the NLS. Resulting stable stream of optical pulses can be used in various communication settings including LANs on Air Force platforms. |
| 2304B | Physical Mathematics & Applied Analysis | Nachman | Dr Cornelius Horgan Applied Math U Virginia Charlottesville VA 22903 (804) 924-7230 | Dr William Avery Boeing Commercial Airplane Group MS/6H-CR Seattle WA 98124 (206) 234-0444 | Generalized the St Venant principle to include anisotropic, sandwich, and other composite materials | Stress concentrations produced by rivets, cutouts, etc are felt in a considerable surrounding area and, in the case of composites, in nonclassical (non St Venant) ways. Such nonlocal loads can lead to debonds in laminated airframe panels. |
| 2304B | Physical Mathematics & Applied Analysis | Nachman | Dr Scott Stewart TAM U Illinois Urbana IL 61801 (217) 333-7947 | Dr Gordon Johnson Alliant TechSystems Inc 600 Second St NE Hopkins MN 55343 (612) 931-5905 | Derived an improved model of detonation front propagation within solid explosives which contains details relevant for modern AF mixtures. Codified the model so that effects of charge shape and fuze position could be examined | A large code called EPIC, which is an Eglin/Alliant code, is exercised at the Eglin Warheads Branch to design warheads for various target scenarios. Stewart's research code has been incorporated into EPIC. |
| 2304C | Computational Mathematics | Schreck | Marsha Berger, Courant Institute, 998-3305 (212) | Capt Mike Afrosimis, Wright Laboratory, Flight Dynamics Directorate, NASA Ames Liaison, (415) 604-4499 | Adaptively refined Cartesian grids give fast discretization and accurate solutions for computational fluid dynamics on complex external aircraft geometries | Adaptively refined Cartesian grids allowed rapid gridding and fast, accurate solution of Euler equations in support of NASA High Wing Transport/C-17 wind tunnel test. |
| 2304C | Computational Mathematics | Schreck | Marsha Berger, Courant Institute, 998-3305 (212) | Earl Duque, US Army Aero- flightdynamics Directorate, (415) 604-4489 | Adaptively refined Cartesian grids give fast discretization and accurate solutions for computational fluid dynamics on complex external aircraft geometries | Adaptively refined Cartesian grids allowed rapid gridding and fast, accurate solution of Euler equations for Army configuration studies of AH-64 Apache helicopter. |
| 2304C | Computational Mathematics | Schreck | Alan Laub, University of California at Santa Barbara, (805) 893-3616 | Kevin J. Shortelle, System Dynamics International, (352) 371-8035 | Improved solution algorithm provides faster, more accurate solutions to the Riccati equation | Improved Riccati equation solver aids nonlinear estimation techniques for improving the accuracy of integrated navigation systems like GPS, INS, Doppler. |
| 2304C | Computational Mathematics | Schreck | Charles Kenney, University of California at Santa Barbara, (805) 893-3616 | Jim Huang, Alphatech Inc., (617) 273-3388 | Small-sample condition estimation quantifies floating point computation errors more accurately and reliably | Small-sample condition estimation quantifies accuracy and reliability of computations for image processing and target recognition. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------------------------|----------|--|---|---|---|
| 2304C | Computational Mathematics | Schreck | Manil Suri, University of Maryland, Baltimore County, (410) 455-2311 | Bob Sanderson, Engineering Software Research and Development, (314) 645-1423 | Hierarchical hp finite element methods for plates and shells reliably arrive at accurate solutions and resolve fine details in stress fields | Quantitative rules for mesh-degree combinations ensure that computation converges to accurate solution and that irregular load distributions are resolved. |
| 2304C | Computational Mathematics | Schreck | Manil Suri, University of Maryland, Baltimore County, (410) 455-2311 | Kamran Izadpanah, MacNeal-Schwendler Corp., (213) 259-4960 | Interface method models problems decomposed into several subdomains | These methods allow complex configurations to be decomposed into simpler subdomains. These are then dealt with concurrently and independently to speed solutions. |
| 2304C | Computational Mathematics | Schreck | Bob Peterkin, Phillips Laboratory/WSP, (505) 846-0259 | Jim Park, NASA Johnson Space Center, (713) 483-1168 | MACH3 is a parallel, coupled, implicit, three-dimensional magnetohydrodynamics code | MACH3 code is used to design and optimize advanced thruster nozzle. This will enable better control of satellite dynamics and longer useful lifetimes. |
| 2304C | Computational Mathematics | Schreck | Bram van Leer, University of Michigan, (313) 764-4305 | Veer Vatsa, NASA Langley Research Center, (757) 864-2236 | Preconditioning algorithms render the discretized representation of physical problems more amenable to computational solution | Preconditioning algorithms have been implemented in NASA CFD software, yielding faster, more accurate and more reliable computational fluid dynamics solutions for engineers and scientists. |
| 2304C | Computational Mathematics | Schreck | Joseph Flaherty, Rensselaer Poly. Inst. (410) 516-7004 | John Jones, Wright Laboratory, Materials Directorate, (513) 255-8787 | Adaptive finite element computational models predict crucial physical quantities in chemical vapor deposition processes | These models characterize chemical vapor deposition and enable formulation of a process controller. This controller speeds processing and reduces waste in manufacturing high-temperature ceramic composites, useful for high-temperature coatings. |
| 2304C | Computational Mathematics | Schreck | Joseph Flaherty, Rensselaer Poly. Inst. (410) 516-7004 | Thomas Hughes, Centric Engineering, (415) 723-2040 | Adaptive finite element computational models predict crucial physical quantities in chemical vapor deposition processes | Chemical vapor deposition prediction software incorporated into Centric Engineering Spectrum Code. This Code is capable of modeling processes for producing high-temperature coatings. |
| 2304D | Optimization & Discrete Mathematics | Glassman | David Goldberg, University of Illinois, (217) 333-0897 | Darell Whitley, Colorado State University, (940) 491-5373 | State-of-the-art image recognition systems were too slow for the DARPA autonomous vehicle project | Genetic algorithm was applied to the detector formation subsystem and outperformed previous best algorithms. |
| 2304D | Optimization & Discrete Mathematics | Glassman | Jerry Brown, Navy Postgraduate School, (408) 656-2140 | Army Base Realignment and Closure Office, Mark Jones, Asst. Chief of Staff for Installation Mgt, BRAC Office, (703) 695-8029; Charles Nemfakus, DUSN, Organizational Management and Infrastructure Team, (703) 693-0258 | Brown has developed new modeling techniques which incorporate "persistence," the requirement that decision makers be able to control the extent to which model results are consistent with previous decisions | This model has been used to analyze the Army's budget requirements and to schedule BRAC actions. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---|----------|--|---|---|--|
| 2304D | Optimization & Discrete Mathematics | Glassman | David Shanno, Rutgers University, (908) 932-5472 | Irving Lustig, CPLEX Optimization, (609) 497-0984 | New, higher order interior methods of optimization have significantly reduced running time for large problems | CPLEX is the most widely used commercial linear programming code. These developments have been incorporated in current or upcoming versions. |
| 2304D | Optimization & Discrete Mathematics | Glassman | Yaakov Bar-Shalom, University of Connecticut, (203) 486-4823 | Richard McAllister, Northrup Grumman, (516) 575-1073 | In sonar problems where there are large angle measurement errors, the standard conversion between polar and Cartesian coordinates causes bias and provides estimates of the covariances that are too small | New formulas were developed and applied to the E2-C upgrade being developed by Northrop-Grumman. |
| 2304D | Optimization & Discrete Mathematics | Glassman | Dr Ruth Pachter, Wright Laboratory, (513) 255-6671 | Pamela Schaefer, Laser Hardened Material Exploratory Program, (513) 255-6671, ext. 3150 | Electronic structure determination of optical limiting materials, particularly meso-alkynyl porphyrins, that utilize the reverse saturable absorption optical mechanism, have guided efforts for the design of the molecular systems for pilot protection | Materials with fast nonlinear optical response over broad spectral bandwidths that are critical for laser eye and sensor protection. |
| 2304D | Optimization & Discrete Mathematics | Glassman | James Malas, Wright Laboratory, (513) 255-8787 | Dr Ron Shaw, McDonnell Douglas, (314) 232-0444; Dr Leon Perez, Crown Pattern and Foundry, (818) 289-3445; Dr Harold Gegel, UES Inc., (513) 426-6900 | Repeated trial and error design was insufficient to deliver a component of the EMD-2 missile with the required mechanical and microstructural properties | VM/ML used concurrent reengineering to define the process parameters needed to achieve the required characteristics. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | D. Healy, Dartmouth College, (603) 646-3327 | Dr Jeffrey Solka, (540) 653-1982, NSWC; Dr Jerry Prince, (410) 516-7031, Integrated Surgical Systems | Multiscale edge representation, source/channel coding; enhanced Computerized Tomography Imagery | Faster Internet image transmission toward Global Infosphere (Reachback Facility); better installation of surgical prosthetics. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | Peter Sherman, Iowa State University, (515) 294-0091 | Dr Robert Bitmead, DSTO, Detection and Evaluation Group, Australia, 61 62 492849 | Cyclo-stationary, spectral correlation methods for machine condition monitoring | Analysis of data from Hot Strip Mill, (NDE). Needed for improved turbine blade and helicopter transmission maintenance. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | Arye Nehorai, Yale University, (203) 432-4260 | J. Polcari, Commander, ASTO (Navy), (703) 604-6013; Dr Ben Gray, (203) 440-5355, NUJWC | Acoustic vector-sensor processing | Source location with hull-mounted sensors. Faster ID of seaborne targets. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | Brian DeFazio, University of Missouri, (573) 882-8183 | Evan Boole, (573) 882-8183, MD Dept. of Radiology, University of Missouri | Information-theoretic image reconstruction with "soft-thresholding", wavelet compression of remote x-ray images | Remote control of X-ray and ultrasound scanners. Enhanced Combat Theater capability for medical corps G390. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|---|---------|---|---|---|---|
| 2304E | Signal Processing, Probability & Statistics | Sjogren | R. Plemmons, Wake Forest University, (910)759-5358 | Dr Don Washburn, (505) 846-1597, Starfire Optical Range PL/LIGR, Kirtland AFB NM | Fast adaptive iterative methods for eigenvalue analysis of large sparse and non-sparse matrices | More accurate, quicker computations for the restoration of space-based objects using deformable mirrors. Part of the space-based object sensing effort. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | Subir Ghosh, University of California at Riverside, (909) 787-3781 | Dr Barry McKinney, (315) 330-2922, Rome Lab (RL/ERDS) | Statistical experimental design and data analysis | Correction to an existing methodology for acceleration reliability test and stress monitoring, taking into account several factors that are not "equi-spaced". Applicable to ALQ-131 Electronic Warfare Pod validation. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | R. Coifman, Yale University, (203) 432-4175 | Roy Matic, (310) 317-5931, Hughes Research Laboratory, Malibu | Adapted waveform analysis, multipole and hybrid methods | Fast computation of electromagnetic scattering (phase, amplitude, positioning), critical to antenna placement on F-22. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | G. Prescott, University of Kansas, (913) 864-7760 | Peter Leong, (315) 330-3226, RL/C3BB, Speakeasy Radio; Larry Gutman, WL/AAWW-2 | Foundational work in LPI Communication Networks | Speakeasy (Joint Services radio compatibility project) needs to factor in communications covertness requirements. Unified standards lets this effort move ahead. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | M.V. Wickerhauser, Washington University, St Louis, (314) 935-6771 | Dr A. Vassiliou, (918) 660-3749, FMA&H Corp., also to Amoco Technology Center; Dr C. Hwa, (408) 365-5430, Litton Industries Appl. Tech.; Dr X. Wang, (314) 362-7111, Washington Univ. Med. Center | Adapted wavelet Analysis Library licensed to FMA&H | Transmission of CAT imagery as part of Electronic Battlefield, Mobile Surgical Hospital reachback and military telemedicine; seismological analysis of mineral-bearing rock. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | Michael Zoltowski, Purdue University, (317) 494-3512 | Dr Jeffrey Bull, (215) 674-5100, Flan and Sussel, Inc. | Advanced adaptive null-steering, 3-D angle estimation with vector sensor arrays | Advanced electromagnetic field sensing. Multipath reinforcement to improve direction finding for received signals. Reduces multipath for improved battlefield Wireless Communication and interferer location. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | Louis Auslander, O.B.E., SUNY, (212) 642-2483 | Hughes Space Co. (Graf Urban von der Embse aus), Saxe-Coburg Goetha, (310) 416-2403 | Classification and study of ergodic transformations according to mixing properties. | Robust and efficient Pseudo-Noise encoding methodologies. Critical for covert CDMA mobile wireless and GPS encoding. |
| 2304E | Signal Processing, Probability & Statistics | Sjogren | Alan Willsky, Lab. for Integrated Decision Systems, MIT, (617) 253-2356 | Dr Donald Brosn, (617) 981-7647, Lincoln Laboratory Satellite Communication Group; Dr Gary Hewer, (619) 939-8414, NAWC, China Lake | Multiresolution methods in laser ranging, tradeoff analysis between image resolution and anomaly rejection. Novel multiple access schemes | Motion detection (optical flow) for rapid detection, ID of moving targets. Development at China Lake for USN Sidewinder missile infrared sensing. Library compression facility for high resolution radar data, medium, long-range surveillance. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|-------------------------|-----------|---|---|--|---|
| 2304F | Systems & Software | Luginbuhl | Cybenko Dartmouth College (603) 646-3843 | Jennifer S. Kay, Lockheed Martin, (609) 338-2014 | Transportable software agent that can move from machine to machine in a distributed network, accomplishing computing tasks on each machine | Information agents that move within a volatile computer network to retrieve data from remote sources, process it, and present summaries to battlefield commanders. |
| 2304F | Systems & Software | Luginbuhl | Smolka SUNY-Stony Brook (516) 632-8453 | Jack Hoffman, Reuters International, (516) 233-6600 | Mathematical modeling of concurrent systems | Modeling and analysis of communications protocol used in worldwide financial trading network. |
| 2304F | Systems & Software | Luginbuhl | Lee Univ of Pennsylvania (215) 898-3532 | Oleg Sokolsky, (215) 854-0555 Computer Command and Control Company | Advances in graphical specification languages and real-time verification techniques | Specification and analysis environment for real-time systems. |
| 2304G | Artificial Intelligence | Waksman | Dr James Crawford, University of Oregon, (503) 346-0473 | Dr Stan Cross, McDonnell Douglas, (503) 346-0473 | New class of algorithms for scheduling and planning | Advanced scheduling algorithm for multi-aircraft assembly. |
| 2304G | Artificial Intelligence | Waksman | Mr Vince Velten, WL/AARA, (513) 255-1115 | Mr Joe Sacksteder, NAIC/PINPOINT Project, (937) 257-7847 | New class of algorithms for IR recognition | Advanced intelligent precision munitions. |
| 2304G | Artificial Intelligence | Waksman | Professor Nandhakumar, University of Virginia, (804) 924-6108 | Mr D. Gerson, CIA/ORD RADIUS Program, (703) 351-2727 | New class of thermal and physical invariants for recognition | Advanced Tracking Radar (ATR) systems. |
| 2304I | Electromagnetics | Nachman | Dr David Dobson Math/TAMU College Station TX 77843 (409) 845-1924 | Dr J. A. Cox Honeywell Technology Center 3660 Technology Drive Minneapolis MN 55418 (612) 951-7738 | Delivered an EM code which couples Maxwell's eqs with optimum design options so that the operation of devices could be both predicted and optimized | An ultra-narrow band, high reflectance filter was designed and optimized for use as a mirror in a vertical cavity surface emitting laser (VCSEL). Such lasers offer attractive optoelectronic and photonic uses for the Air Force. |
| 2304I | Electromagnetics | Nachman | Dr Jeff Herd RL/ER 31 Grenier St Hanscom AFB MA 01731 (617) 377-8904 | Mr Kevin Ommodt Texas Instruments MS 8019 PO Box 801 McKinney TX 75080 (214) 952-3779 | Analysed the EM output of a microstrip patch antenna array and codified the result. This code has the greatest generality and functionality of any available | Phased array antennas have many virtues (agility, light-weight, conformality to fuselages) which are attractive to the Air Force. The TI effort is specifically concerned with AF Milsatcom program. |
| 2304I | Electromagnetics | Nachman | Dr Vladimir Olier Matits Inc 1565 Adelia Pl Atlanta GA 30329 (404) 248-9926 | Dr Shang Lee DEMACO Inc. 100 Trade Center Drive Suite 303 Champaign IL 61820 (217) 355-4748 | A novel application of differential geometry to problems of EM surface ray tracing with special emphasis on effects of local curvature of airframes | An upgrade to XPATCH, the high frequency code most frequently used by the AF to predict airplane scattering attributes (including RCS), will be realized as a result of the ability to more accurately account for local fuselage/wing curvature effects. |
| 2310B | Ionospheric Research | Kroll | Dr Tom Wilheit, Texas A&M, College Station, TX, (409) 845-0176 | Ron Isaacs, AER, Inc., (617) 547-6207 | Ocean Microwave Emission Model | Used in the development of Unified Retrieval Cloud Detection Algorithms. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
|---------|----------------------|-------|--|---|---|--|
| 2310B | Ionospheric Research | Kroll | Dr Tom Wilheit, Texas A&M, College Station, TX, (409) 845-0177 | Dr Xiaoli Zou, NCAR, (303) 497-8916 | Ocean Microwave Emission Model | Used in the development of 4D data assimilation algorithm development for the MM5 mesoscale prediction model. |
| 2310B | Ionospheric Research | Kroll | Dr Alan Lipton, PL/GPA, (617) 377-2491 | Ron Issacs, AER, Inc., (617) 547-6207 | Corrections and improvements to the RADTRAN radiative model database | Used in the development of Unified Retrieval Cloud Detection Algorithms. |
| 2310B | Ionospheric Research | Kroll | Mr George Modica, PL/GPA, (617) 377-2956 | Dr Bill Kuo, NCAR, (303) 497-8910 | Algorithm to solve the radiative transfer equation for the microwave EM spectrum | Development of 4D data assimilation algorithms to incorporate SSM/T-2 data into MM5 mesoscale model initialization. |
| 2310B | Ionospheric Research | Kroll | Mr George Modica, PL/GPA, (617) 377-2956 | Dr Alan Lipton, PL/GPA, (617) 377-2491 | Algorithms to compute the cloud liquid water accumulated under adiabatic ascent for a given atmospheric layer | Create and evaluate cloud layer models used to construct radiative transfer algorithms. |
| 2310B | Ionospheric Research | Kroll | Dr Bill Kuo, NCAR, (303) 497-8910 | AFGWC, Offutt AFB, NE, Col Hayes, DSN 271-5749 | MM5 mesoscale prediction model | Used as a theatre scale prediction model to support Bosnian peacekeeping mission. |
| 2310B | Ionospheric Research | Kroll | Dr Paul Krehbiel, NMIMT, (505) 835-5215 | Mr Ken Cummings, (520) 741-2838, Global Atmospherics, Inc., Tucson AZ | Development of an experimental Lightning Detection and Ranging system | Develop similar technology to support the National Lightning and Detection Network. |
| 2310B | Ionospheric Research | Kroll | Dr T.N. Krishnamurti, Florida State University, (904) 644-6205 | Mr Russel Treadon, (904) 644-2732, National Center for Environmental Prediction, Camp Springs, MD | Physical initialization algorithms for global atmospheric prediction models | Initialization schemes applied to National Weather Service prediction models. |
| 2310B | Ionospheric Research | Kroll | Dr T.N. Krishnamurti, Florida State University, (904) 644-6205 | Mr Greg Rohaly, (408) 656-4722, US Naval Oceanographic and Meteorological Prediction Facility | Physical initialization algorithms for global atmospheric prediction models | Initialization schemes for the Navy's NOGAPS global prediction system. |
| 2310B | Ionospheric Research | Kroll | Dr Larry Maht, Oregon State University, (503) 737-5691 | Mr Ray Kiess, AFGWC, Offutt AFB, NE, (402) 294-3373 | Land surface exchange algorithms for numerical weather prediction | Input to real-time diagnostic agrometeorological model in support of AFGWC meteorological predictions. |
| 2310B | Ionospheric Research | Kroll | Dr John Jasperse, PL/GPI, (617) 377-3083 | Dr E. Bauer, Institute for Defense Analysis | Data on ionospheric variability at high latitudes | Targeting error analysis associated with BMIEWS UHF radar systems. |
| 2310B | Ionospheric Research | Kroll | Dr John Jasperse, PL/GPI, (617) 377-3083 | Dr R. Wolf, Rice University | Auroral electron precipitation rate algorithms | Incorporation into the Magnetospheric Specification Model. |
| 2310B | Ionospheric Research | Kroll | Dr Edward Weber, PL/GPI, (617) 377-3121 | 50th Space Weather Squadron Falcon AFB, CO | Physical algorithms to explain the formation, evolution and decay of equatorial plasma depletions | Input into a prototype Scintillation Network Decision Aid (SCINDA) program to specify effects on UHF SATCOM systems. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
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| 2311A | Space Physics | Radoski | Dr Richard Radick, PL/GPSS, (505) 434-1390 | Capt D. Rider, PL/UH, DSN 246-4735 Dr R. Benedict, (505) 242-9992, W.J. Schager Associates | Procedures for high precision photometric observations of space objects | Develop and improve methods for observations of spacecraft using ground based facilities such as the Air Force telescope on Maui. |
| 2311A | Space Physics | Radoski | Dr Richard Altrock, PL/GPSS, (505) 434-7016 | J. Hirman, NOAA/SESC, (303) 497-5688, Lt Col C. Tschani, (719) 554-9140, AFSPC/50WS | Daily maps and graphs of solar coronal activity | Used for prediction of space weather. |
| 2311A | Space Physics | Radoski | Dr Stephen Keil, PL/GPSS, (505) 434-7039 | Maj R. Kutzman, (719) 554-9140, AFSPC/50WS, Falcon AFB | Report on an upgraded solar observing network | Used as the basis for a decision to replace the existing SOON telescopes. |
| 2311A | Space Physics | Radoski | Dr Richard Altrock, PL/GPSS, (505) 434-1390 | Maj R. Kutzman, (719) 554-9140, AFSPC/50WS, Falcon AFB | Technical advice on improving the solar optical observing network | Used to determine the feasibility for developing various optical systems. |
| 2311A | Space Physics | Radoski | Dr Donald Neidig, PL/GPSS, (505) 434-7019 | Lt C. Tujo, Mr R. Shweid, AM-ALC/LHW, DSN 633-0590, Mr C. Mitchell, AWS/SYDS, DSN 576-3840, ext 328 | Study of a new generation instrument for collecting solar data for operational commands | Used to begin a cradle to grave effort for SOON. Represents a major transition of observing techniques and telescope technology. |
| 2311A | Space Physics | Radoski | Dr Donald Neidig, PL/GPSS, (505) 434-7019 | Capt R. Davila, AWS/XOXT, DSN 576-5631, ext 494 | Investigation of magnetic shear as a flare predictor | Determined that routine measurements of vector magnetic fields alone would improve the prediction of flares and coronal mass ejections. |
| 2311A | Space Physics | Radoski | Dr Donald Neidig, PL/GPSS, (505) 434-7019 | A. Starr, (505) 475-3461, Det 4, AFSPC/50WS, Holloman AFB | Training on new techniques and instrumentation | Used to introduce SOON personnel to solar monitoring and forecasting. |
| 2311A | Space Physics | Radoski | Dr Donald Neidig, PL/GPSS, (505) 434-7019 | Capt R. Davila, AWS/XOXT, DSN 576-5631, ext 494 | Data on the requirements for space weather forecasting | Used to improve the quality and accuracy of solar forecasting. |
| 2311A | Space Physics | Radoski | Mr Don F. Smart PL/GPSS, (617) 377-3978 | Dr James Adams, (202) 767-2747, D.O. Hulburt Center for Space Research, NRL | Technical information on the procedure to determine radiation dose to high flyers | Contributed to a report on the Human Presence in Space as a part of the NRL Space Weather program. |
| 2311A | Space Physics | Radoski | Mr Don F. Smart PL/GPSS, (617) 377-3978 | Dr Michael J. Golightly, (281) 483-6190, NASA Johnson Space Center, SN31, Houston, Texas | PC version of the proton prediction model | Used to predict solar proton intensities after a major solar flare. Used at NASA during manned space operations. |

| Subarea | Title | PM | Performer | Customer | Result | Application |
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| 2311A | Space Physics | Radoski | Ms Margaret Shea, PL/GPSG, (617) 377-3977 | Dr David H. Smith, (202) 334-3477, Space Studies Board, National Academy of Sciences | Information on space weather | Used for reports on Space Weather and for a scientific workshop at Sacramento Peak Observatory. |
| 2311A | Space Physics | Radoski | Mr S.W. Kahler, PL/GPSG, (617) 377-3978 | Lt Kelly Fedel, (301) 981-2270, USAF, Suite EEO100, 1535 Command Drive Andrews AFB | Data on Japanese efforts in solar physics and space weather forecasting | Increase the data base of foreign researchers and institutes working in areas of interest to USAF. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea, PL/GPSG, (617) 377-3977 | Dr George R. Davenport, DSN 692-7750, ARINC Incorporated, Colorado Springs, CO | Information on solar-terrestrial phenomena and space weather | Establish a capability to address space weather effects on operational military and civilian systems. |
| 2311A | Space Physics | Radoski | Mr E. W. Oliver PL/GPSG, (617) 377-3975 | Ms. Helen Coffey, (303) 497-6223, STP Division, National Geophysical Data Center, NOAA, Boulder, CO | Algorithms for reading solar radio data acquired by the USAF Radio Solar Telescope Network | Used to create displays of solar radio data to make assessments of solar driven space weather phenomena. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea, PL/GPSG, (617) 377-3977 | Dr Michael J. Golightly, (281) 483-6190, NASA Johnson Space Center, SN31, Houston, Texas | Information on solar-terrestrial phenomena that affect the space environment | Used for briefings on solar-terrestrial and space weather effects on NASA operations. |
| 2311A | Space Physics | Radoski | Mr E. W. Oliver PL/GPSG, (617) 377-3975 | Ms. Helen Coffey, (303) 497-6223, STP Division, National Geophysical Data Center, NOAA, Boulder, CO | Technical information on sweep frequency records of solar metric radio activity | Used for post-analysis of solar induced geophysical disturbances to allocate archival resources related to space weather. |
| 2311A | Space Physics | Radoski | Mr E. W. Oliver PL/GPSG, (617) 377-3975 | Mr Kevin Scro, (719) 567-6332, 50th Weather Squadron, Falcon AFB, Colorado | Software to expedite processing of real time solar wind plasma and magnetic field data | Provide improved forecast of geomagnetic storms to DOD customers with C3I systems that depend on the space environment. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Ron Turner, (703) 416-3264, ANSER, Arlington Virginia | Technical information on solar proton events | Used to assess the risk for manned space missions to the moon and to Mars. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Ms Nicole D. Kernness, (607) 751-4758, LORAL, Owego, New York | Technical information on galactic cosmic radiation, neutron monitors and solar particle events | Used to study measurements of neutron monitors in support of efforts to understand single event upsets. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea, PL/GPSG, (617) 377-3977 | Dr D.S. Toomb, (909) 624-0175, SAVE Inc., Claremont, CA | Technical information on solar proton events and cosmic radiation | Used to correlate anomalies on an Air Force spacecraft with space weather to develop more robust future designs. |

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| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Mr Karin Johansson, 46-18-530-265, Saab Military Aircraft, Linköping, Sweden | Technical information on cosmic radiation and solar particle events | Used to understand the environment at aircraft levels, especially the possibility of single event upsets. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Henry Zakrzewski, (714) 896-5215, McDonnell Douglas Aerospace, Huntington Beach, CA | Technical information on solar proton events | Estimate the effect of the space radiation environment on the electronic devices used in Delta launch vehicles and on other missions. |
| 2311A | Space Physics | Radoski | Mr S. W. Kahler, PL/GPSG, (617) 377-3978 | Dr James Klimchuk, (202) 404-8136, NRL Space Sciences Division, Code 7675, Washington, D.C. | Design details of the Solar Mass Ejection Imager and information on the detection of coronal mass ejections | Incorporated into a report on the forecasting of space weather phenomena. |
| 2311A | Space Physics | Radoski | Mr Don F. Smart, PL/GPSG, (617) 377-3978 | Dr Gregory Ginet, (617) 377-3974, PL/GPSP, Hanscom AFB, MA | Software to predict the onset time of a geomagnetic disturbance from a solar shock wave | Incorporated into the PL/GP Geospace Program to be used by the USAF 50th WS at Falcon AFB, Colorado. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea, PL/GPSG, (617) 377-3977 | Mr E. Erwin, (303) 497-6133, STP Division, National Geophysical Data Center, NOAA, Boulder, Colorado | Information from neutron monitors on the maximum cosmic ray intensity during a relativistic solar proton event | Used to compile cosmic radiation data from neutron monitors since the start of measurements in 1953. |
| 2311A | Space Physics | Radoski | Mr Don F. Smart, PL/GPSG, (617) 377-3978 | Capt. Carter Borst, (303) 497-5999, 50th Weather Squadron, NOAA, Boulder, Colorado | Software to predict the radiation dose to air crews from cosmic radiation | Used to predict the radiation dose to air crews from galactic cosmic radiation anywhere in the world at altitudes up to 87,000 feet. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea, PL/GPSG, (617) 377-3977 | Dr Fumihiko Tomita, 81-86-544-2155, Hiraiso Solar Terrestrial Research Center, 3601 Isozaki, Hitachinaka, Ibaraki 311-12, Japan | Information on the relationship between solar proton flux above 50MeV and single event upsets | Incorporated in to the support given to Japanese satellite operation groups, especially for spacecraft in geosynchronous orbit. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Jack Grandman, (303) 341-3928, Hughes Aircraft Company, Aurora, Colorado | Technical Information on cosmic radiation and solar particle events | Used to understand the onset of single event effects and the possibility of predicting when they might occur. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr David J. Strobel, (619) 679-9087, Space Ellectronics, Inc. San Diego, CA | Technical information on galactic cosmic radiation and solar particle events | Used to support engineering modeling of new microelectronic products and for incorporation into a space parts handbook. |

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| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Farhad Radpour, (310) 336-5000, Hughes Space and Communications, El Segundo, CA | Technical information on galactic cosmic radiation and solar particle events | Used as background material for radiation effects assessments and analysis programs. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Rocky Koga, (310) 336-6583, The Aerospace Corporation, El Segundo, CA | Technical information on galactic cosmic radiation and solar particle events | Used in efforts to support Air Force operations in space. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Bill Heidergott, (602) 732-4285, Motorola, Government and Systems Technology Group, Chandler, Arizona | Information on galactic cosmic radiation, solar proton events and geomagnetic cut off rigidity values | Used to understand the environment in which the Iridium satellites operate. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Mr Ron Travis, (508) 443-9521, Nuclear and Space Radiation Effects and Analyses, Raytheon Co., Sudbury, MA | Information of the space environment, cosmic rays and solar particle events | Used to understand the environment that can induce single event effects for application to the Trident Missile. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Virgil H. Strahan, (714) 538-1337, Autonetics Electronic Systems Division, Rockwell International Corporation, Anaheim, California | Technical information on solar particle events and galactic cosmic radiation | Used in support of GPS and Rockwell's ground based interceptor program. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr Jack Woods, (617) 981-4028, Satellite Communications Technology Group, MIT Lincoln Laboratory, Lexington, MA | Information on galactic cosmic radiation and geomagnetic cutoff rigidities | Used in a Lincoln Laboratory satellite program. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr John L. Andrews, (610) 354-3840, Lockheed, Martin Astro Space, Philadelphia, PA | Information on galactic cosmic radiation and solar proton events | Used as background information for programs on survivability of space systems. |
| 2311A | Space Physics | Radoski | Ms Margaret Shea and Mr Don F. Smart, PL/GPSG, (617) 377-3977 | Dr John W. Adolphsen, (301) 776-8886, Eng. Consulting Service Fulton, MD | Information on galactic cosmic radiation and solar proton events | Used in support of NASA programs at Goddard Space Flight Center. |

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| 2311A | Space Physics | Radoski | Dr Michael Heinemann, PL/GPSP, (617) 377-8660 | Maj Mike Christi, DSN 692-3242, Peterson AFB, CO | Algorithm for improved magnetic field mapping | Used in the operation of the Magnetospheric Specification and Forecast Model by the 50th Weather Squadron. |
| 2311A | Space Physics | Radoski | Dr Gregory Ginot and Dr William Burke, PL/GPSP, (617) 377-9658 | Maj Mark Confer, (617) 377-2433, DSN 478-2433, Program Manager, USAF PE 63410F, Space Systems Environmental Interactions Technology, Hanscom AFB, Massachusetts | Analysis of electron heating observed in the OEDIPUS C sounding rocket experiment | Used to explain high levels of energetic electrons caused by an on-board radio wave source observed by particle sensors on the rocket. |